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## USE OF FILTERED ULTRA-VIOLET LIGHT IN DIAGNOSIS OF THE VARIOUS TYPES OF RYE-GRASS IN NEW ZEALAND.

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THE separation of the seeds of perennial rye-grass (*Lolium perenne* L.) from those of Italian rye-grass (*L. multiflorum* Lam.) has at no time presented difficulty when the characteristic terminal awn of the last-named species has been in evidence. When, however, the awn has become removed during machine-dressing, the seeds of the two species from a superficial examination are identical, and the detection with any degree of certainty of Italian rye-grass in samples of perennial is practically impossible. Hellbo, in 1925, demonstrated the possibilities of diagnosis by observation of the presence in Italian and absence in perennial rye-grass of teeth on the marginal nerves of the outer palea, but observations have shown that while this characteristic may be fairly constant for hand-gathered material it becomes uncertain when applied to machine-dressed seed through the removal of the marginal teeth during dressing.

The recent discovery, therefore, by Dr. G. Gentner of the State Seed Control Station, Munich, that the roots of seedlings of Italian rye-grass grown on white filter-paper would bring about a condition in the paper which when examined under filtered ultra-violet light would render it fluorescent, while the seedlings of perennial rye-grass under identical conditions would not, is a matter of outstanding importance.

The application of Gentner's method to the commercial rye-grasses of Great Britain by Linehan and Mercer, of the Department of Agriculture, Northern Ireland, resulted in their showing that the ability to exhibit fluorescence was peculiar not only to Italian and other annual species of *Lolium*, but was also exhibited by certain seedlings of perennial rye-grass, which were, by growing-on tests, identified as the intermediate false perennials. The identification of ten-day seedlings of de-awned Italian rye-grass, important as it is, is from an economic point of view far outweighed by the possibility of identification of inferior types of rye-grass without the necessity of a plot trial. The application of this method of identification is of particular value to

New Zealand. As has been shown by Levy and Davies, the seed produced in this country represents several distinct plant-types, which vary considerably in economic value, and it has been the purpose of the present work to demonstrate the possibilities of the Gentner method in the classification of seed into its potential plant-type.

## Technique of the Test.

A Hanovia quartz mercury vapour lamp, fitted with a filter or screen which allows only light of a wave-length between 3,000 and 4,000 Angström units to pass, has been used for the work.

The seeds to be examined are placed to germinate on white filter-paper disks in the manner usual for a standard-type germination test. The tests are put down in four, six, or eight lots of fifty seeds per disk, the degree of accuracy of the test depending of course upon the number of replications. On the sixth day, the disk with the now germinated seedlings is placed under screened ultra-violet light, when the filter-paper immediately in contact with the rootlets of all of the seedlings of Italian rye-grass, and some or all of those of false perennial, exhibits a brilliant blue fluorescence. In the case of true normal perennial rye-grass, the reaction is, as far as can be ascertained, absolutely negative.

To estimate the percentage of positively reacting seedlings, these are removed from the filter-paper, counted, and recorded, and the test returned to the germinator. Two further examinations are made, one in two days, and a final one in an additional eight or ten days—a total test period of sixteen to eighteen days. The non-reacting seedlings are not removed from the disk during the test, but are allowed to remain so that they may root firmly on to the paper. Only a very small percentage of seedlings show fluorescence after the twelfth day. Linehan and Mercer record their occurrence up to eighteen days, but in this case the non-fluorescent seedlings were removed at each examination and placed on fresh filter-paper, which removal delays the reaction somewhat. At the completion of test the remaining seedlings are counted, and the number of fluorescent seedlings is expressed as a percentage of the total germinated seedlings.

Filter-paper appears to be an essential medium in the test, as fluorescence has been observed on no other material. The fluorescent material appears to be the product of a reaction between an exudate from the roots of positive plants and some substance or substances present in the paper, but so far as the writer is aware no definite explanation of the phenomenon has been recorded. It is possible that the exudate is one or a combination of a group of enzymes, and that this reacts with the cellulose, starches, or alkalis present in the paper, the result being a fluorescent substance of unknown composition. At the moment, however, interest lies with the effect rather than the cause, although a wider application of the method might be possible when the nature of the reacting material is known.

The presence of the exudate in the rootlets of certain species and varieties of *Lolium* appears to be constantly associated with the short-life factor, as complete fluorescence is exhibited by all of the annual species. Linehan and Mercer record it in Italian rye-grass, Western

Wolths (*L. multiflorum* Lam., var. *Westerwoldicum*), darnel (*L. temuletum* L.), *L. remotum* Schrank., and *L. Brazilianum* Nees, while the writer has observed it also in Wimmera rye-grass, an annual variety, originating in New South Wales.

While the ability to produce a fluorescent substance on paper appears to be peculiar to the genus *Lolium*, a direct fluorescence is exhibited by other plants. Under screened ultra-violet light the roots of oats (*Avena sativa* L.) show an intense violet blue, as do to a much lesser degree the rootlets of *Danthonia* spp., *Bromus hordeaceus* L., and *Bromus unioloides* H.B.K. A faint blue fluorescence has been observed in the rootlets of newly germinated seedlings of all forms of *Lolium*, but this disappears in a few days. Mature plants of Italian and false perennial, if allowed to root on to filter-paper, show the fluorescent character in the same manner as the seedlings. In strongly fluorescent plants the fluid content of the roots, and some cases of the leaves, when forced out on to filter-paper immediately shows faintly the characteristic blue under the quartz lamp.

## The New Zealand Experiments.

The results of the tests by Linehan and Mercer on a range of unclassified samples supplied by the Agrostologist, Plant Research Station, in 1930, have been published, and a close correlation has been made between the percentages given by them and the Agrostologist's classification. A duplicate set of these samples was made available to the writer by the Agrostologist for examination under the quartz lamp. The results of the tests, together with those of Linehan and Mercer, and the classification as determined by plot trial, are shown in Table 1. Although the New Zealand figures are generally a little higher there is very close agreement between the two groups of results, and our figures confirm the observation of Linehan and Mercer " that the results are of interest, and, if of general application, would seem to warrant the conclusion that the use of the ultra-violet-light test provides a ready laboratory method for distinguishing seed samples of the valuable Hawke's Bay strains from those inferior ones emanating from other districts of New Zealand."

Since making these original tests the writer has examined over 500 samples, representing over 100,000 seedlings, the majority of the samples having previously been classified by plot trial as representing plant-types 1, 3, and 4. It was reasonably obvious from an examination of the earlier test results that there would not be a definite line of demarcation between the types, and that a small percentage of borderline cases would occur between Types 1 and 3 which, on a basis of percentage fluorescence, might be difficult to classify; hence the concentration of this work on these two particular types.

Before discussing the behaviour of the different types under ultra-violet light it will be of advantage to state briefly the classification of New Zealand rye-grass proposed and instituted by Levy and Davies, as follows:—

Type 1: Hawke's Bay, Poverty Bay, and a few of the best Sandon; deep green in colour; dense leafy growth; rapid recovery after cutting; erect, multi-tillered, persistent.

Type 2: Mainly Sandon; rather lighter in colour; slightly less persistent; otherwise very close to No. 1.

Type 3: Best of South Island lines; green to slightly greyish green; divaricating habit; open at the crown; shoots more prostrate; persistence equal to No. 2.

Type 4 (false perennial): Bulk of the Southland, Otago, and Canterbury lines; light greyish-green in colour; divaricating habit; open crown; in persistency much inferior to No. 3.

Type 5: Inferior South Island lots, typical in colour and growth form. In many respects this form shows close affinities with Italian rye-grass, and in some ways is suggestive of a derivative of crossing between the normal false perennial of Type 4 and ordinary Italian.

Type 6: Italian rye-grass.

*Table 1.—Comparative Tests correlated with Classification of the Samples worked by Linehan and Mercer.*

| Record No. | Origin. | Plant-type No. | Content of Italian. | Percentage of Germinated Seedlings showing Fluorescence. | |
|---|---|---|---|---|---|
| | | | | Linehan and Mercer. | New Zealand. |
| 3 | Hawke's Bay .. | 1 | Trace .. | 1 | 2·3 |
| 4 | ,, .. | 1 | Some .. | 3 | 5·6 (6·7*) |
| 5 | ,, .. | 1 | ,, .. | 2 | 1·3 |
| 6 | ,, .. | 1 | ,, .. | 1 | 2·3 |
| 7 | ,, .. | 1 | Trace .. | 1 | 1·1 |
| 9 | ,, .. | 1 | .. | 2 | 1·0 |
| 10 | ,, .. | 1 | .. | 2 | 2·0 |
| 11 | ,, .. | 1 | Some .. | 3 | 3·4 |
| 12 | ,, .. | 1 | Trace .. | 4 | 3·0 |
| 14 | ,, .. | 1 | .. | 2 | 2·5 |
| 15 | ,, .. | 1 | Trace .. | 3 | 2·2 |
| 17 | ,, .. | 1 | ,, .. | 1 | 1·5 |
| 13 | ,, .. | 1 | Some .. | 1 | 2·5 |
| 20 | ,, .. | 1 | Trace .. | 1 | 3·2 |
| 22 | ,, .. | 1 | ,, .. | 1 | .. |
| 23 | ,, .. | 1 | .. | 4 | 6·0 |
| 24 | ,, .. | 1 | .. | 1 | 1·0 |
| 25 | ,, .. | 1 | .. | .. | 1·4 |
| 205 | ,, .. | 1 | .. | 1 | 2·6 (2·1*) |
| 206 | ,, .. | 1 | Trace .. | 2 | 2·4 |
| 207 | ,, .. | 1 | ,, .. | 1 | 4·7 (5·0*) |
| 208 | ,, .. | 1 | ,, .. | 2 | 2·7 |
| 209 | ,, .. | 1 | ,, .. | 2 | 1·3 |
| 210 | ,, .. | 1 | ,, .. | 1 | 2·8 (2·3*) |
| 147 | Southland .. | 3 | .. | 13 | 24·4 |
| 194 | ,, .. | 4 | Some .. | 59 | 58·0 |
| 195 | ,, .. | 3 | Trace .. | 6 | 13·3 (14·3*) |
| 197 | ,, .. | 5 | Mixed .. | 98 | 97·6 |
| 198 | ,, .. | 5 | ,, .. | 81 | 80·0 |
| 196 | ,, .. | 3 | Trace .. | 19 | 21·6 |
| 199 | ,, .. | 5 | Some .. | 97 | 96·0 |
| 200 | ,, .. | 3 | Trace .. | 9 | 12·3 |
| 225 | Canterbury .. | 3 | Some .. | 15 | 13·4 |
| 40 | ,, .. | 4 | Much .. | 14† | 41·0 |
| 26 | ,, .. | 5 | Mixed .. | 100 | 98·6 |
| 184 | South Canterbury .. | 3 | Some .. | 11 | 11·5 |
| 183 | ,, .. | 5 | Mixed .. | 94 | 94·0 |
| 186 | ,, .. | 5 | ,, .. | 94 | 90·0 |
| 149 | Marlborough .. | 4 | Some .. | 33 | 32·8 |
| 150 | ,, .. | 3 | ,, .. | 15 | 14·0 |
| 182 | Wairarapa .. | 3 | Much .. | 10 | 17·0 |
| 164 | Central Otago .. | 5 | Some .. | 96 | 96·4 |
| 218 | Maniototo .. | 5 | Much .. | 71 | 85·0 |

* Check figures. † Probably misprint.

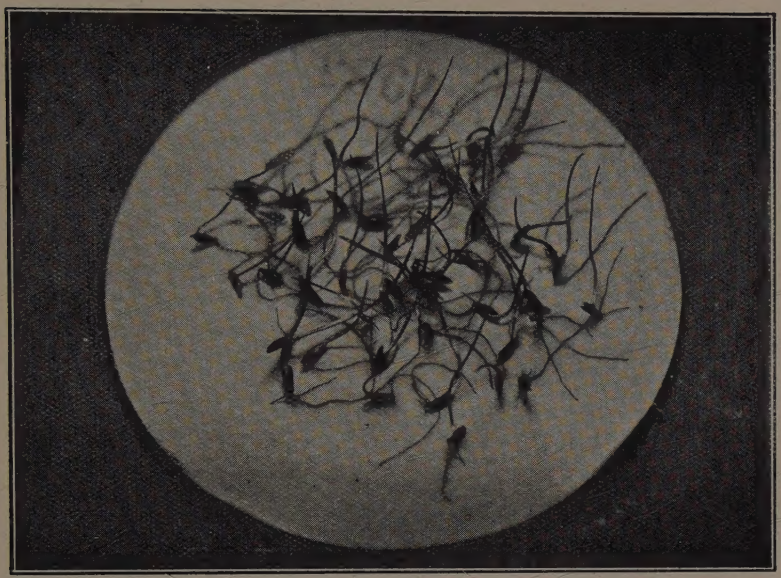

FIG. 1. FIFTY TEN-DAY SEEDLINGS OF TYPE 1, PERENNIAL RYE-GRASS, PHOTOGRAPHED UNDER SCREENED ULTRA-VIOLET LIGHT.

In this test there was an entire absence of fluorescence.

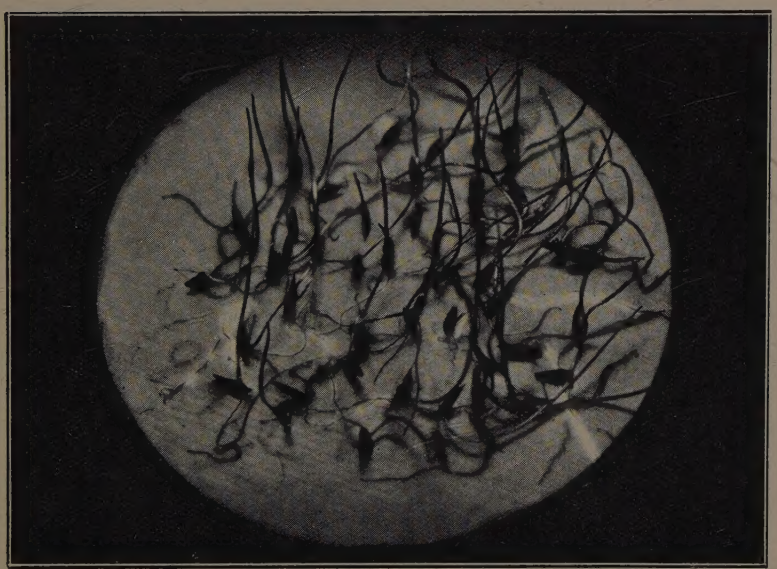

FIG. 2. FIFTY TEN-DAY SEEDLINGS OF TYPE 3, FALSE PERENNIAL, SHOWING APPROXIMATELY 10 PER CENT. OF FLUORESCENCE.

[*Photos by H. Drake.*

*Table. 2.—Grouping, according to the Percentage of Fluorescent Seedlings, of Samples previously classified on Plot Trial.*

H.B. = Hawke's Bay; P.B. = Poverty Bay; S.I. = South Island; Cant. = Canterbury; South. = Southland.

| Group. | Range Percentage of Fluorescent Seedlings. | Plant-type No 1. | | | | | Plant-type No. 3. | | | | | | | Plant-type No. 4. | | | | | Class. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Number of Samples. | | | | Percentage of all Samples. | Number of Samples. | | | | | | Percentage of all Samples. | Number of Samples. | | | | Percentage of all Samples. | |
| | | H.B. | P.B. | S.I. | All. | | H.B. | P.B. | Cant. | South. | Other S.I. | All. | | Cant. | South. | Other S.I. | All. | | |
| | Totals | 154 | 55 | 23 | 232 | .. | 7 | 9 | 27 | 29 | 20 | 92 | .. | 11 | 30 | 15 | 56 | .. | .. |
| | Up to 3 .. | 116 | 30 | 16 | 163 | 70 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | |
| I | Up to 5 .. | 148 | 47 | 22 | 217 | 93 | 5 | 4 | .. | 3 | 3 | 15 | 16 | .. | .. | .. | .. | .. | Type No. 1. |
| II | 6 to 10 .. | 6 | 8 | 1 | 15 | 7 | 1 | 3 | 14 | 5 | 10 | 33 | 36 | 2 | .. | .. | 2 | 4 | |
| III | 11 to 20 .. | .. | .. | .. | .. | .. | 1 | 1 | 10 | 16 | 4 | 32 | 35 | 2 | 4 | 1 | 7 | 12 | Type No. 3. |
| IV | 21 to 30 .. | .. | .. | .. | .. | .. | .. | 1 | 3 | 3 | 2 | 9 | 10 | 1 | 2 | 1 | 4 | 8 | |
| V | 31 to 60 .. | .. | .. | .. | .. | .. | .. | .. | .. | 2 | 1 | 3 | 3 | 1 | 8 | 2 | 11 | 20 | Type No. 4. |
| VI | 61 to 90 .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 3 | 10 | 6 | 19 | 34 | |
| VII | Over 90 .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 2 | 6 | 5 | 13 | 22 | Type No. 5. |

The material used for the present tests comprised 149 certified samples (1931 season) as representative of Type 1, and 148 samples supplied by the Agrostologist classified on plot trial into Types 3 and 4. The results of the tests on samples of all three types are set out in Table 2. Five per cent. of fluorescent seedlings is tentatively suggested as a maximum percentage for seed which could be termed true perennial. It might well be supposed that lines of seed which are represented to be true perennial, as, for example, certified seed, would in all cases give a totally negative test. This, however, is not the case, as, although true perennial does not exhibit fluorescence generally, there are present in varying percentages seeds of de-awned Italian and false perennial which give the characteristic reaction. Furthermore, as is suggested by the data in Table 1, the percentage of positively reacting seeds indicates not only the character of those particular seeds. but also in the majority of cases the character or potential plant-type of the seeds which do not exhibit fluorescence. The ultra-violet-light test may not therefore be regarded as quantitative in the determination of a proportion of superior and inferior strains, but as a qualitative test by virtue of the possibilities of diagnosis of the plant-type of the whole.

### The Test in Relation to Type Classification.

In order to correlate the ultra-violet-light-test percentages with the plant classification of Levy and Davies, three maximum percentages for Types 1, 3, and 4 respectively have been adopted as follow :—

Type 1 : Up to and including 5 per cent. of fluorescent seedlings.
Type 3 : 6 to 20 per cent., both inclusive.
Type 4 : 21 to 90 per cent., both inclusive.
Type 5 : 91 to 100 per cent., both inclusive.

These maxima are shown in Table 2.

*Plant-type 1.*—Of the total number of samples examined, 93 per cent. showed less than 5 per cent. fluorescent seedlings, the remaining 7 per cent. being placed in the 6–10-per-cent. group (see Table 2). In general, the samples from Poverty Bay showed a higher average percentage of positive seedlings than did the Hawke's Bay samples, which tends to confirm the general observation that in the former district false perennial is present to a greater extent than in Hawke's Bay.

The following tabulation summarizes the data obtained for certified seed :—

| Origin. | Percentage of Samples showing | | | Average Percentage of Fluorescence. |
|---|---|---|---|---|
| | Up to and including 3 per Cent. | Up to and including 5 per Cent. | Over 5 per Cent. | |
| Hawke's Bay .. .. | 72 | 90 | 10 | 2·9 |
| Poverty Bay .. .. | 50 | 70 | 30 | 4·3 |
| South Island ("First Harvest") | 65 | 80 | 20 | 3·4 |
| All samples .. .. | 65 | 84 | 16 | 3·4 |

*Plant-type 2.*—For all practical purposes this type has appeared to have been merged with Type 1. At all events, no definite separation can be made between Nos. 1 and 2 by means of the ultra-violet test.

*Plant-type 3.*—Of the ninety-two samples representing plant-type 3, fifteen samples, or 16 per cent., are placed within the 5-per-cent. fluorescent group—that is, according to the ultra-violet-light test these fifteen samples must be regarded as being equal to Type 1. It is of interest to note, however, that of this number nine were from Hawke's Bay and Poverty Bay, three from Southland, one from Otago, one from Central Otago, and one from Marlborough. Furthermore, twelve of the fifteen have been classified from plot trial as "better than typical," which is taken by the writer to signify a position somewhat intermediate between Types 1 and 3.

Of the remaining 84 per cent. of the total number of samples, 36 per cent. fall within the 6–10-per-cent. group and 35 per cent. in the 11–20-per-cent. group. A boundary-line for Type 3 has therefore been drawn at 20 per cent., which separates 13 per cent. of the samples into Type 4. The samples supplied by the Agrostologist were classified as "better than typical," "typical," and "poorer than typical," which groups for convenience have been termed 3A, 3B, and 3C respectively. The use of this sub-classification affords further evidence of the correlation between plot trial and the ultra-violet-light test. As already stated, the majority of the samples within the 5-per-cent. group were classified as 3A; the groups 6–10 per cent. comprise mainly 3A, 11–15 per cent. 3B, and the group 16–20 per cent. 3C. The average percentage of fluorescent seedlings for the subclasses is in consequence representative. The percentages are as follow:—

28 samples 3A showed 6·5 per cent. average.
42 samples 3B showed 11·7 per cent. average.
22 samples 3C showed 16·0 per cent. average.

*Plant-type 4.*—A considerable number of Type 4 samples are still under test, but it is considered that the data obtained from the tests of fifty-six samples is sufficient to give a fairly accurate indication of the behaviour of this class.

Of the fifty-six samples nine, or 16 per cent., fall within the 6–20-per-cent. group, and thereby qualify for Type 3 classification. Of the remainder thirty-four, or 62 per cent., of the samples may be classified as typically No. 4, and thirteen, or 22 per cent., in the 90-per-cent. group as Type 5. Taking the percentages for the subclasses 4A, 4B, and 4C, there is again a marked conformity with plot-type classification.

8 samples classed 4A showed 13·2 per cent. average.
30 samples classed 4B showed 58·0 per cent. average
18 samples classed 4C showed 80·0 per cent. average.

*Plant-type 5.*—In all samples tested, a percentage of 90 to 100 per cent. of fluorescent seedlings was obtained.

*Plant-type 6.*—All samples examined showed 100 per cent. fluorescence.

## Practical Application of the Method.

From the evidence presented, it is considered that the value of the quartz lamp in the diagnosis of potential plant-type in rye-grass has been established. With classification dependent upon the numerical expression of a single character—fluorescence—in place of a group of characters as shown by growing plants, a very small percentage of border-line cases must occur. In such cases, however, further tests with increased replications would provide ample evidence for confirmatory classification.

FIG. 3. FIFTY TWELVE-DAY SEEDLINGS OF TYPE 5, FALSE PERENNIAL, SHOWING OVER 90 PER CENT. OF FLUORESCENCE.

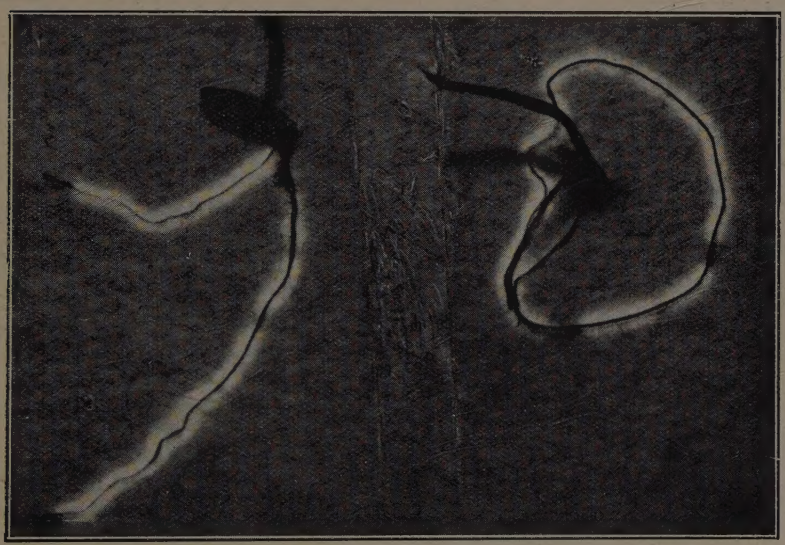

FIG. 4. TWO INDIVIDUAL SEEDLINGS OF FALSE PERENNIAL. ABOUT 2½ TIMES NATURAL SIZE.

Note the absence of fluorescence where the radicle of the seedling at the right is not in contact with the paper. [*Photos by H. Drake.*

The fixing of a maximum of 5 per cent. of fluorescent seedlings for Type 1, and thus admitting into that class a small proportion of those lines previously classified as "better than typical" Type 3 may be open to argument; but lowering the maximum to 3 per cent. and eliminating all Type 3 limits considerably the number of lines already classified on plot trial as Type 1. However, seeing that the demand for certified seed is considerably in excess of the supply, it is considered that until the supply is increased it may be advantageous to admit as "mother seed" all lines showing up to 5 per cent. of fluorescent seedlings, and later, if necessary, lower the maximum to 4 per cent. and then to 3 per cent., thus eliminating all lines except those of definitely superior type. From a practical point of view, the relationship between the ultra-violet-light test percentages and the subclasses of Type 3 need not be viewed so critically. Certainly there seems a fair degree of merit shown by lines designated "typical 3," and it may be taken that a line showing approximately 10 per cent. of fluorescent seedlings is far superior to lines showing more than 20 per cent., and it is possible that lines of the former type will for some time to come justifiably find a place on the New Zealand market.

When the test is offered as an additional service to the seed trade it is hoped that full advantage will be taken of it, and that before very long the commercial value of uncertified rye-grass will be assessed not only on its percentages of purity and germination, but also on its percentage of fluorescent seedlings. The trend in the rye-grass trade to-day is towards propagation of the superior types, with elimination of the inferior types. The application of the ultra-violet-light test to all trade samples in the same way as the germination is used would materially hasten the disappearance of the less persistent types of rye-grass.

## Underlying Factors discussed.

At the present juncture it is difficult to offer any definite explanation as to the causes underlying the appearance in a group of a more or less fixed percentage of plants carrying the factor or factors for fluorescence, and to the relationship between that percentage and the plant-type representative of the group.

To obtain data as to the exact nature of positive and negative reacting material in the various classes, some five thousand seedlings have been removed from the test pads and planted out for examination. Pending the result of these examinations, it is perhaps of interest to review briefly hypotheses which could account for the behaviour under the quartz lamp of the various classes of hybrid perennial.

It must be accepted that—

(*a*) Genetically pure perennial does not exhibit fluorescence, or is always negative.

(*b*) Genetically pure Italian does exhibit fluorescence, or is always positive.

(*c*) The hybrid individual may or may not exhibit fluorescence.

(*d*) For each of the classes of rye-grass there is a more or less definite proportion in which the positive and negative reacting individuals occur.

(*e*) The proportion of fluorescent individuals is smallest in the most persistent class and greatest in the least persistent class; there is a

distinct negative correlation between the proportion of fluorescent individuals characteristic of the class and the degree of persistency.

The points to be determined are—

(*a*) Of the plants bearing the factors for fluorescence, what type of individual do the 5 per cent. in Type 1, 10 per cent. in Type 3, and 50 per cent. in Type 4 represent?

(*b*) Are they identical, or

(*c*) Are they progressively inferior, and, if so,

(*d*) To what degree in other characteristics do they differ from non-fluorescent individuals in the respective types?

It may be concluded alternatively that—

(*a*) If all positive plants, irrespective of type, were identical, then the converse must be true, and all negative plants would be identical irrespective of type. Consequently Types 3, 4, and 5 would in the main

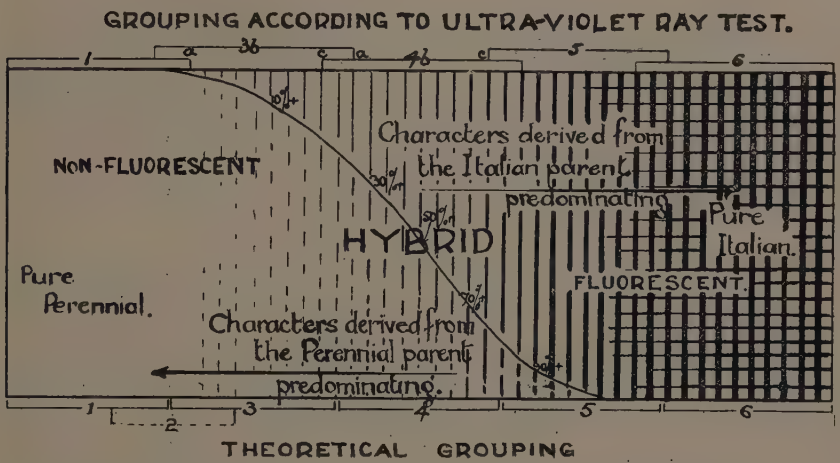


FIG. 5. GRAPHICAL REPRESENTATION OF RELATIONSHIP BETWEEN POSITIVE AND NEGATIVE MATERIAL IN EACH OF THE RYE-GRASS TYPES.

be composed of two classes: First, the negative reacting class, a degenerate perennial; and, second, a positive reacting class, a hybrid resulting from Italian crossed with true perennial or degenerate perennial.

(*b*) If all positive plants in Types 3, 4, and 5 exhibit a retrogressive degree of inferiority in proportion to their relative number, the same must be true of the negative reacting plants, which must become retrogressively inferior with decrease of numbers; from this, superficially positive and negative plants within a type to all appearances must be identical.

In regard to conclusion (*a*), it is pointed out that the observations and conclusions of Levy and Davies do not suggest that Types 3, 4, and 5 are degenerate perennials and hybrids in mixture in varying proportions, and, furthermore, one would not be inclined to regard this view as logically correct.

The alternative conclusion (*b*) then appears to be the more acceptable; but although it is possible to advance theories as to the course of the factors for fluorescence and for persistency and to postulate the existence of controlling factors, it is considered advisable to wait until the material planted out has matured sufficiently to allow of examination and comparison, one class with another. Finally, the selfing of selected plants representative of each class is expected to yield many confirmatory data.

An interpretation of the relationship between the positive and the negative material in each of the types is suggested graphically in Fig. 5. Although this will no doubt be subject to later modification, it serves to emphasize the fact that the percentage of positive seedlings in a sample does not indicate partial equality with true perennial, but, rather, the degree of perenniality.

## Acknowledgments.

The writer wishes to acknowledge his indebtedness to Mr. E. Bruce Levy, Agrostologist, for the supply of a wide range of seed samples of known plant type, together with recorded field data; to Mr. H. Drake for his perseverance in photographing a difficult subject, which, so far as the writer is aware, has not been previously successfully photographed; to Mr. Graydon, of Messrs. W. Watson and Sons, Wellington, for the loan of apparatus for the preliminary work; and to the seed-testing staff for the carrying-out of the routine work in connection with the required germination tests.

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*Inspection and Registration of Plant Nurseries.*—Reports from officers of the Horticulture Division covering the year 1930–31 indicate that the bulk of the nurseries in the Dominion are kept in good condition, and that the stock raised is well up to standard and clean and free from disease. Nurseries registered during the year numbered 662, and £662 was collected in registration fees.

# THE MILKING SHED AND YARDS.

J. W. SMITH, Dairy Instructor, Whangarei.

THE milking shed plays a very important part in dairy-farming operations, and the progressive dairy-farmer recognizes that a well-planned and properly equipped shed materially assists in the production of finest-quality milk or cream. Comfort and convenience at reasonable cost are also major considerations, while sanitation and hygiene must always be foremost in the mind.

## THE SITE.

The first and most important consideration is the selection of the site. The site should be governed by the fall for drainage, proximity to an adequate and permanent water-supply, the contour of the ground, convenience for working the herd back to respective paddocks, and distance from road, &c.

In the lay-out of the shed due consideration must be given to the direction of the prevailing wind, care being taken to have the milk-collecting or separator room at the windward end. It is also desirable to have the drainage flowing from the milk-room, &c., through and past the shed to a sump at least 30 ft. away from the outer edge of the yard.

## FOUNDATIONS.

It is recommended that the foundation walls of the milk-collecting or separator room be of concrete and at least 2 ft. 6 in. high, provision being made for six spaces for ventilation in the three outer walls as shown in the accompanying plan; the remaining wall requires to be draught-proof. The extreme end wall of the shed should have a similar concrete foundation, but without ventilators. The structure should be fastened down by means of bolts set in the green concrete of all foundations to be built upon. Foundations so erected not only facilitate the cleansing, but add considerably to the life and strength of the building.

The front portion of the bails may be dealt with in either of the following ways: (1) By a concrete wall not less than 4 in. high, to be capped by the main plate throughout the length of this section and unbroken at doorways; (2) by concreting to a height of at least 4 in. only that portion covered by the dummies.

## FLOORS.

All concrete floors should be not less than 3 in. thick and finished to a fairly smooth surface. Gateways should be reinforced with wire or pig netting. The fall in the floor of the shed from bails to gutter should be not less than 4 in. in 10 ft. towards the gutter. It has been the experience of practical farmers that cows will slip more readily on a floor that is comparatively flat than on a floor with the fall mentioned. It has also been proved that a floor of this description requires less water for cleansing purposes. A fall in the holding-yard of 3 in. in 10 ft. proves sufficient and should be towards the main gutter. The gutter should be so situated as to gather all the drainage from the

milk-room and convey it as direct as possible to the sump. The fall in the gutter should not be more than 1 in. in 10 ft. A dwarf concrete wall 3 in. high round the sides of the holding-yard is recommended. This prevents objectionable matter collecting and falling over the outer edges, thereby causing contamination.

### The Race.

The width of the race in front of the dummy bails is governed by the type of cow to be milked. For instance, an average Jersey cow steps forward 2 ft. 3 in., whereas a Friesian steps forward 3 ft. 3 in. Therefore the width of the race in each case needs to be increased by 9 in., which will allow ample room for the cows to clear doorways.

The fall in the race from shed to outer edge of the race can be 1 in. in 3 ft. or thereabouts. A 3 in. dwarf wall on the outer edge of the race forms a drainage recess. There should be in this recess a fall of 1 in. in 10 ft. around and towards the main gutter, as shown in the plan.

The race shown in the plan is recommended where practicable, the milked cows being worked back to the original entrance. In this way only a gateway need be metalled, and the front of the shed is kept sweet and clean. Under these conditions the mud, if any, is kept at the extreme point from the milk-collecting room. In the working of a race of this description it is imperative that all doors should open the one way, as shown in the plan.

### Drainage Sump.

The Dairy Industry Act, 1908, requires that pigs shall not be kept within 50 yards of a dairy, while no fowl-house, manure-heap, cesspit, or closet may be kept within 30 ft. The word "dairy" includes the shed and yards. The drainage sump should therefore be situated at least 30 ft. from the outer edge of the shed proper, preferably on the lee side, and made of concrete with the following dimensions: Length, 8 ft.; width, 3 ft.; thickness of walls, 4 in.; depth, first three sections 16 in., last section 21 in. The divisions between these sections are removable, and can be made of timber of suitable strength fitted into a recess in the concrete wall.

The discharge of drainage into a creek has several objectionable features. It is a waste of useful manure, and may also contaminate a water-supply. A sump readily cleaned, and worked in conjunction with a portable liquid-manure tank, is therefore recommended.

### Ventilation.

In the construction of any milking shed or dairy it is necessary that ample ventilation be provided for. This can be accomplished by adhering to the details of ventilation shown on the plan, in conjunction with ventilation ports in the concrete foundations as already mentioned.

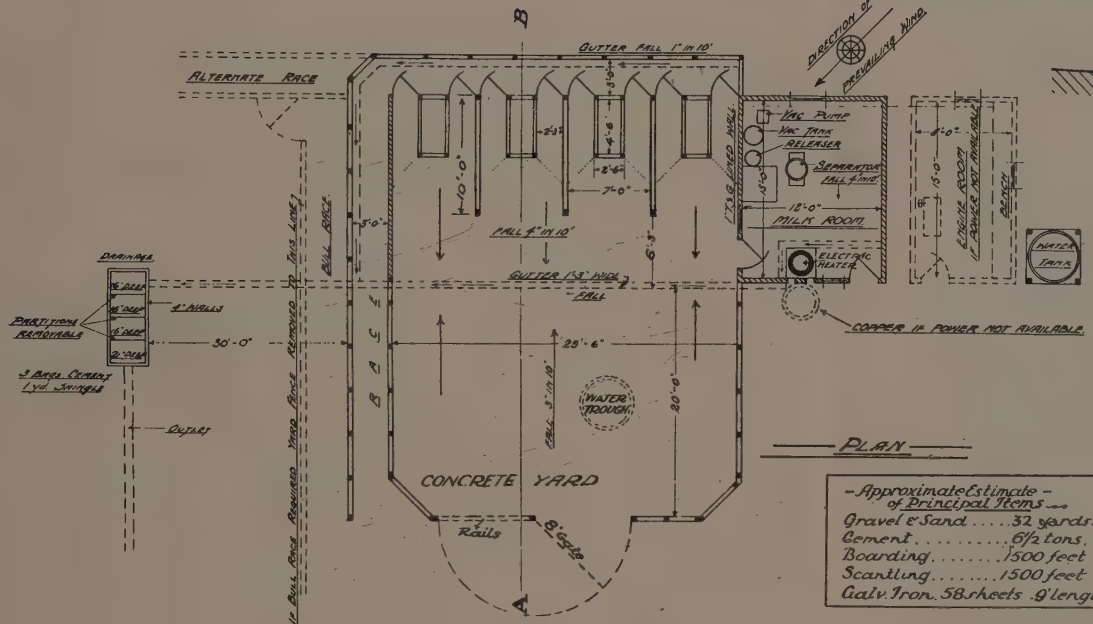
### Shed Construction.

In setting out the building the open portion of the shed should so face as to allow the sun's rays to penetrate into the shed during the greatest portion of the day. It is necessary to have the outlet doors in the front of the shed, which is also the highest part of the building, as shown by the side elevation on the plan.

# DESIGN FOR WALK-THROUGH MILKING SHED, RACE AND YARDS.

## DEPARTMENT OF AGRICULTURE

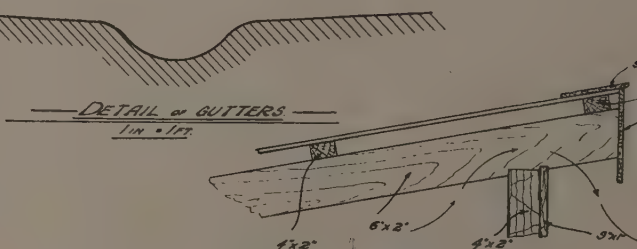
### DAIRY DIVISION.




PLAN

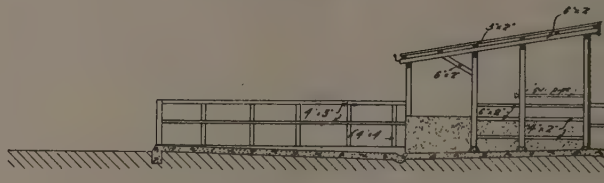
-Approximate Estimate of Principal Items-

| | |
|---|---|
| Gravel & Sand | 32 yards. |
| Cement | 6½ tons. |
| Boarding | 1500 feet |
| Scantling | 1500 feet |
| Galv. Iron | 58 sheets 9' lengths |



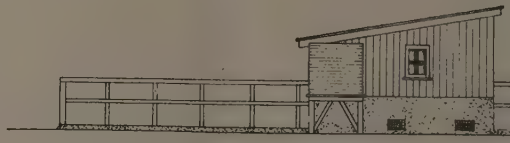

DETAIL OF GUTTERS
1 IN. = 1 FT.

DETAILS OF VENTILATION
1" = 1 FOOT

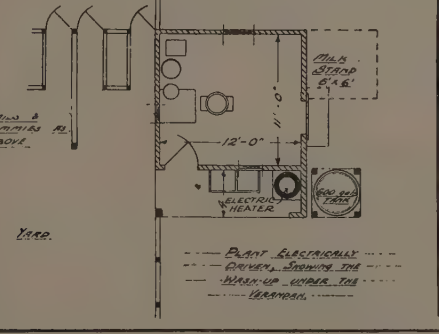


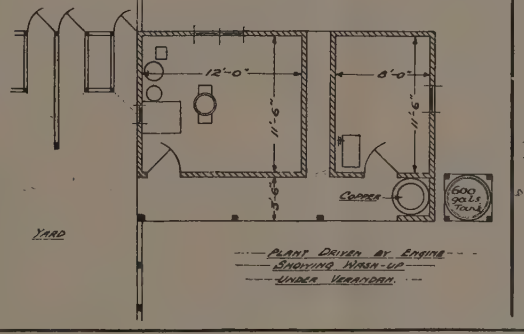
CROSS SECTION

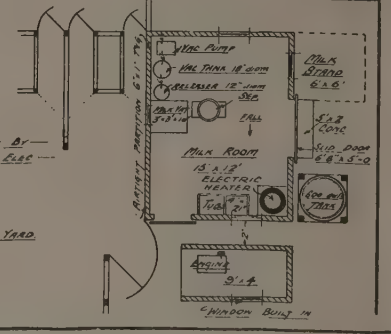
FRONT ELEVATION

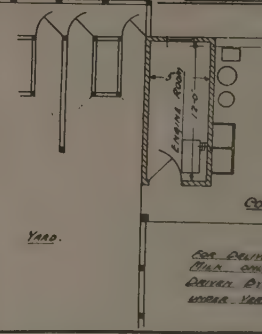


SIDE ELEVATION




NOTE —Larger copies of this plan may be obtained free of cost on application to the Director, Dairy Division, Department of Agriculture, Wellington, or to any officer

According to Health Department requirements, and to enable a license to be obtained for a town-supply dairy, it is necessary that all boarding be erected vertically. The wall between the milking shed and the milk-collecting room must be draught-proof and constructed of tongued and grooved boarding, with the planed surface inside the milk-room.

The main pillars supporting the shed should be stepped up on a small concrete base to keep the bottom of the pillars dry, or upon piping set in with the floor foundations, thereby prolonging their life. Small oil-drums set into the floor foundation and filled with concrete, and having eyelets for leg-ropes, &c., have been used by some farmers for this purpose. Braces from main pillars to rafters make it unnecessary to use further pillars for supporting the roof at the outer edge. This is a decided advantage in the working of the cows into the dummies.

### Dummy Bails.

These can be either supported from the floor or suspended from the roof, but the latter method proves most effective, leaving the floor of the shed unobstructed. When suspended dummies are adequately braced they are as rigid as those supported from the floor.

### Gateway.

If the gateway is left 16 ft. wide, with one central post, the gudgeons being fixed to the outside of the post, the gate can be used in two different positions. The side not in use can be railed off with slip rails. This arrangement really gives two gateways, and lessens trouble with mud in wet weather.

### The Milk-room.

Where milking-machines and a separator are used, the positions of the respective units in the milk-room are shown in the plan. These positions should on no account be altered if the maximum efficiency is to be obtained. If the shed is operated with electric power the motor can be fixed to the wall overhead, or on a block of concrete raised from the floor, or to a bench that is stayed out from the wall.

The type of rotary vacuum-pump now being manufactured occupies a small space and can be fixed to the wall. A most important point to remember when erecting a milking-machine is that the space required in any plant from releaser to vacuum pump need not exceed 4 ft. 6 in. A saving can therefore be effected by adopting right methods, using a minimum amount of piping, and always keeping the vacuum tank adjacent to the vacuum pump.

An electric motor, a vacuum pump, or a vacuum tank are not in themselves a source of contamination to milk or cream. These units should be so installed as to be conveniently cleaned. The milk-vat can be suspended from the roof with iron rods, or supported upon a pipe stand set into the floor, or upon hinged wall-brackets. A convenient milk-vat measures 3 ft. by 3 ft. by 10 in. deep, with a fall and the tap towards one corner. Where a pipe stand is used to support this type of milk-vat an adjustable bar or two hooks

FIG. 1. MILKING SHED OF H. A. HANDCOCK, AT AWAHURI.

Built to the design of "Alternate plan No. 1" in the accompanying plan. Part of the race is shown at the right-hand side of the shed.

FIG. 2. SEPARATOR ROOM IN MR. HANDCOCK'S MILKING-SHED.

Showing the drive for the separator and part of the pumping arrangements for receiving the skim milk, the vacuum pump attached to the wall, vacuum tank adjacent to the pump, the releaser, part of the milk-receiving vat, separator, &c. The space between the vacuum pump and releaser is 4 ft. 6 in.

attached to the stand on the side nearest to the door, as shown in the plan, will serve to support a milk-cooler.

By giving the vat one quarter turn, and bringing the milk-cooler into operation, the milk can be cooled into cans suitable for

town supply. A glazed drain-pipe of a suitable size set into the concrete floor and filled with concrete makes an excellent stand for a separator. It will be noticed that in the plan a small fixed window is shown in the draught-proof wall. This is recommended, as it has been found a decided advantage in the running of the plant, and for carrying out herd-testing work, &c.

FIG. 3. SEPARATOR ROOM AT A. G. DAWICK'S MILKING SHED, AWAPUNI, MANAWATU.

This room is fitted up for the separation of milk and the cooling and storing of milk for town supply.

### USE OF MILK-ROOM AS MILK-STOREHOUSE.

Where whole milk is being supplied the milk-room can be used as a milk-house, provided it is kept in a sanitary condition. This obviates the necessity for a milk-stand, provided the contour of the ground will allow the cart-wheels or roadway to be lowered towards the doorway. A sliding doorway can be made in either of the outer walls of the milk-room to suit the conditions. This is being practised by some dairymen who have proved conclusively over a period of years that good milk, with a low bacterial count and suitable for town supply, can be delivered from a milk-room so constructed.

### WATER-HEATING APPLIANCES.

The boiling-point of water is 212° F. An ordinary copper, when properly fitted in, is one of the best means for obtaining boiling water, because it can be made to actually boil. After using ample boiling water for cleansing the whole milking-plant, &c., a small

quantity of water can be put into the copper, and by means of a device fitted to the copper steam can be very cheaply generated to sterilize the dairy utensils.

There are various makes of electric water-heaters on the market to-day, and when properly installed and equipped they are proving highly efficient.

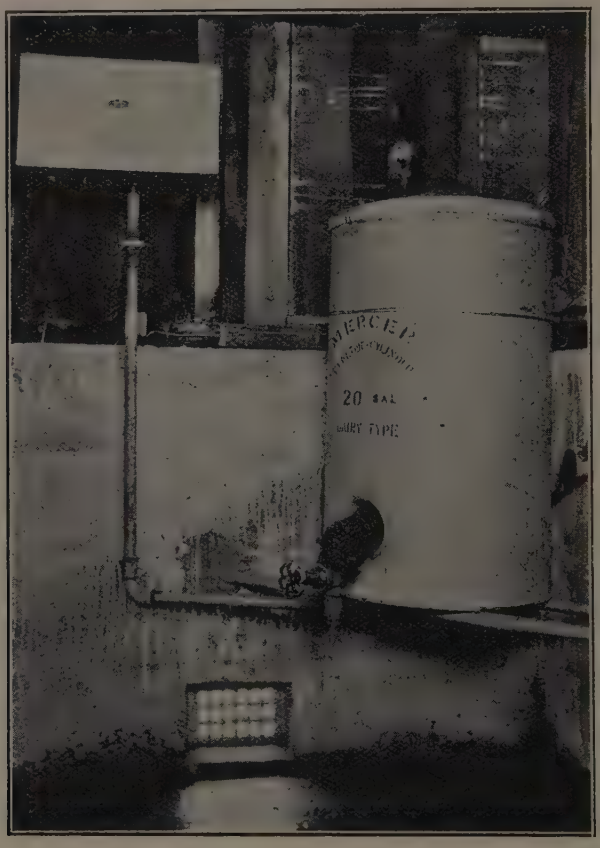



FIG. 4. ELECTRICAL HEATER IN USE AT MR. HANDCOCK'S MILKING SHED.

A tank for supplying water to the heater is attached to the wall, and the bottom of the heater is provided with a drainage outlet. The photo also shows part of the 3-ft.-high concrete wall of the room and one of the ventilating ports.

## Arrangements for washing-down Dairy, &c.

A 600-gallon tank cannot in itself be considered to provide adequate water for all purposes. Where water has to be pumped into a tank it is advisable to place the tank upon a stand at least 12 ft. to 14 ft. high to obtain pressure for cleansing purposes. A water-pipe at least $1\frac{1}{4}$ in. in diameter should be carried overhead from the tank to a central position in the milking shed. A full-way cock of the pressure type should be fitted. Connections from the main water-pipe can be taken off, where suitable, to supply the various units in the dairy requiring

water. The practice is to reduce down from the stop-cock (which is the main sluicing medium) by a series of pipes or connections to a ½ in. pipe, to which can be fitted a ¾ in. rubber hose of any desirable length. The end of the rubber hose can be further reduced down by piping to a ¼ in. nozzle. Such an arrangement assists in speeding up the cleansing operations, and has proved satisfactory. Some dairymen use a rubber hose, as already described, and fit to the delivery-pipe of the pump two full-way stop-cocks, and utilize the pump as the pressure medium. This method works well, but care needs to be exercised in the manipulation of the full-way cocks. A device for assisting to clean the cow-yard can be made by boring small holes every 9 in. in a ¾ in. pipe, which extends the full width of the yard at gate-entrance, and can be merely cemented into or supported upon the concrete floor. A controlling tap on the pipe-line can be fitted in a handy position to suit the operator.

## Materials for Shed, and Approximate Cost of Construction.

Following is a list of materials required for the shed shown in the plan, and approximate prices under average conditions, together with estimated cost of labour :—

| | £ | s. | d. |
|---|---|---|---|
| Spouting brackets | 0 | 12 | 0 |
| Spouting, 56 ft. | 1 | 8 | 0 |
| Tank | 5 | 10 | 0 |
| Galvanized corrugated iron, 58/9 at 4s. 6d. | 13 | 1 | 0 |
| 40 lb. lead-headed nails at 7d. | 1 | 3 | 4 |
| 56 lb. 2½ in. nails<br>28 lb. 3 in. nails } Say, 1 cwt. nails<br>14 lb. 4 in. nails | 1 | 15 | 0 |
| 11 pairs 16 in. Scotch tee hinges | 2 | 15 | 0 |
| 4 single sashes | 4 | 0 | 0 |
| Timber : 3,000 ft. at 27s. 6d. | 41 | 5 | 0 |
| Labour : Carpenters at 10s. per 100 ft. | 15 | 0 | 0 |
| Metal : 32 yards metal at 10s. | 16 | 0 | 0 |
| Cement : 6½ tons at £6 10s. | 42 | 5 | 0 |
| Labour, making and spreading concrete : Three men with mixer, 8 yards per day, at £2 12s. | 10 | 8 | 0 |
| Total | £155 | 2 | 4 |

*Details of Timber.*

| | Super. feet. |
|---|---|
| Bottom plate, 4 in. by 2 in. : 5/16, 2/13, 2/9<br>Top plate, 4 in. by 2 in. : 7/16, 2/13, 2/9 | 186 |
| Top plate on posts, 6 in. by 3 in. : 2/16 | 48 |
| Top plate on studs, 4 in. by 3 in. : 2/16 | 32 |
| Top plate on dummies, 4 in. by 2 in. : 2/16 | 22 |
| Posts, 4 in. by 3 in. : 3/9 | 27 |
| Dummy posts, 4 in. by 4 in. : 8/10 | 107 |
| Division rails, 6 in. by 2 in. : 6/10 | 60 |
| Division rails, 4 in. by 2 in. : 3/10<br>Dummy rails, 4 in. by 2 in. : 8/5, 8/8 | 90 |
| Milk-pipe rail, 6 in. by 1½ in. : 2/16 | 24 |
| Door-studs, 4 in. by 3 in. : 5/10 | 50 |
| Wall-studs, 4 in. by 2 in. : 8/10, 15/7, 10/6, 11/5 | 300 |
| Braces, 6 in. by 1 in. : 6/10 | 30 |
| Dwangs, 3 in. by 2 in. : 100 super. ft. | 100 |
| Rafters, 6 in. by 2 in. : 17/18 | 306 |
| Purlins, 3 in. by 2 in. : 150 super. ft. | 150 |
| Weatherboards, 1 in. : 1,400 super. ft. | 1,400 |
| Barge and cover boards, 6 in. by 1 in. : 4/18 | 36 |
| Fascia, 8 in. by 1 in. : 60 lineal ft. | 40 |
| | 3,008 |

# A BACTERIAL WILT DISEASE OF BEANS.

## OCCURRENCE IN MARLBOROUGH AND MEASURES FOR CONTROL.

W. D. REID, Mycological Laboratory, Plant Research Station, Palmerston North.

IN February, 1931, specimens of Canadian Wonder bean (*Phaseolus vulgaris* L.) affected with a bacterial disease were forwarded to the Mycological Laboratory of the Plant Research Station by Mr. A. G. Elliott, Instructor in Agriculture, Blenheim. The symptoms present were similar to those typical of certain bacterial diseases of the bean in other countries, where for many years serious crop losses due to wilt, defoliation, or death of the plants have been an annual occurrence.

These diseases(4)*, known as "bean-wilt," "bacterial blight of beans," and "halo blight," are transmitted from season to season mainly by seed infection, and so far the only satisfactory control of the disease has been obtained by the use of disease-free seed. The appearance of a bacterial disease of beans in New Zealand was therefore of importance to both the growers and merchants, and necessitated an investigation of those factors which have a bearing on the development of control measures. On receipt of the infected bean plants an immediate survey of the affected areas was initiated by the Mycologist, and carried on through the season by Mr. Elliott.

This survey showed that approximately 25 per cent. of the crops were affected, but the amount of disease in the crops varied considerably. Prior to the 1930–31 season the disease had not been observed in New Zealand, and apparently it was introduced by sowing infected imported seed. This latter contention is supported by the fact that in several cases imported lines sown on isolated ground, not previously in beans, produced badly diseased crops. The disease was noted on and isolated from Canadian Wonder bean, butter bean, and scarlet runner bean.

### SYMPTOMS OF THE DISEASE.

In the field the symptoms produced varied according to the age of the plant at the time of infection, the part attacked, and whether infection was primary as a result of seed infection, or secondary. Primary infections produced characteristic small unthrifty patches, the plants of which showed wilt, leaf and stem lesions, or were devoid of leaves and pods. Secondary infections were more evenly distributed, and in late season were limited to leaf and pod lesion infections. At the time of inspection the crops were nearing maturity, and it was the late-season pod-infections which exhibited symptoms typical of bacterial infection, whereas the symptoms of the earlier primary and secondary infections could be confused with those due to other pathogens. In the following descriptions of the various symptoms field material has been used, supplemented by that produced by inoculation experiments.

* Reference is made by numbers to the bibliography at the end of this article.

Isolation of the causal organism from field specimens at first presented difficulties owing to the presence of saprophytes resembling *Phytomonas phaseoli*, but later isolations gave bacteria which proved to be pathogenic. Pathogenicity was tested by pricking the leaves, stems, and pods of the Canadian Wonder bean plants with suspensions of the various isolations. These suspensions were prepared from single colony isolations of beef peptone agar slopes, usually twenty-four to forty-eight hours old, but it was shown in the pathogenic cultures that slopes up to six weeks old were equal in virulence to younger slopes. The plants were grown from New Zealand disease-free seed, and after inoculation were kept under isolated conditions at a temperature between 65° and 80° F.

FIG. I. WILT OF CANADIAN WONDER BEAN SEEDLING FOLLOWING INOCULATION.

At the point of inoculation, indicated by a white cross, ooze globules are showing. [*Photo by H. Drake.*

### LEAF INFECTION.

In the field leaf infection is shown by the presence of dark-green or brown lesions of variable size and irregular outline. Two or more lesions may coalesce to form dry brown dead areas, but usually the remainder of the leaf is by this time wilted or dead and the outline of the lesion indefinite. On green leaves recent infections sometimes produce a surrounding light zone which is comparable with the condition known as "halo blight" in the United States of America(4). In inoculation tests the first appearance of infection is the formation in two to three days of this light zone, which may sometimes be up to 1·75 cm. in diameter; or, if the zone does not appear, the first obvious change is the formation of a small brown patch—3 mm. in diameter in eight to ten days—and a darkening of the veins around this area. By the time the lesion is definite the leaf is flaccid and curled. Death of the leaf rapidly follows, but further progression of the disease appears to be checked at the base of the petioles.

### STEM INFECTIONS.

On the stems the lesions are indefinite in outline, at least in mature plants, and the tissues are not stained deeply. Usually in old plants the lesions are light brown or reddish brown with an uneven margin. In succulent plants stem infections do not show a marked colour change, but rather a shrinking and wilting of the diseased parts. Inoculation by pricking first produces a faint light streak above and below the point of infection. This streak becomes water-soaked and slowly increases in size, in six to eight days being from 1·5 cm. in length and 0·3 cm. in width. The surface of the lesion becomes somewhat sunken, and in eight to twelve days gives rise to small beads of milky or creamy ooze. Darkening of the affected tissue is not noticeable even after three weeks, but by this time the portions of the plant above the point of inoculation are withered and dead. Progression of the organism below the point of inoculation is very slow, for lower portions of the plant remain healthy for many weeks.

On the pods the spots are definite in colour and outline, and the spotting is the only field symptom which can be taken as a definite indication of the presence of the disease. The lesions are usually circular, and the colour varies with age of pod or age of infection. In green pods on inoculation a water-soaked spot 3 mm. in diameter forms immediately round the point of entry. This condition remains, and the lesion extends with a slight darkening of this initial area. In the field green pods show the same symptoms. After six to eight days the enlarged water-soaked area is slightly sunken, and often gives rise to a milky exudate, which later dries on the lesion as a whitish film. With increasing age the lesions do not materially increase in size, but darken in colour, ultimately becoming dark green or brown. Similar but smaller lesions are produced by applying a bacterial suspension to the pod without injuring the surface. Under experimental conditions the pod may turn yellow and die, but, as is the case in leaf inoculations, the disease might not progress beyond the petiole. In mature dry pods

the diseased portions are variable in colour, some lesions being light brown in the centre with a darker brown outer zone, others are reddish brown, while others again are dark brown with or without a darker border. Where the initial infection points are numerous and close together, the diseased areas might coalesce and cause distortion and shrinking of the infected parts.

FIG. 2. POD OF CANADIAN WONDER BEAN WITH LESIONS RESULTING FROM INOCULATION.

[*Photo by H. Drake.*

## SEED INFECTION.

Where the pod lesions are large or are confluent the underlying seeds are certain to be infected, and normally show a faint-yellow or light-brown staining of that part of the testa adjacent to the diseased portion of the pod. However, staining of seed is not a

FIG. 3. LESIONS ON PODS OF CANADIAN WONDER BEAN NATURALLY INFECTED.

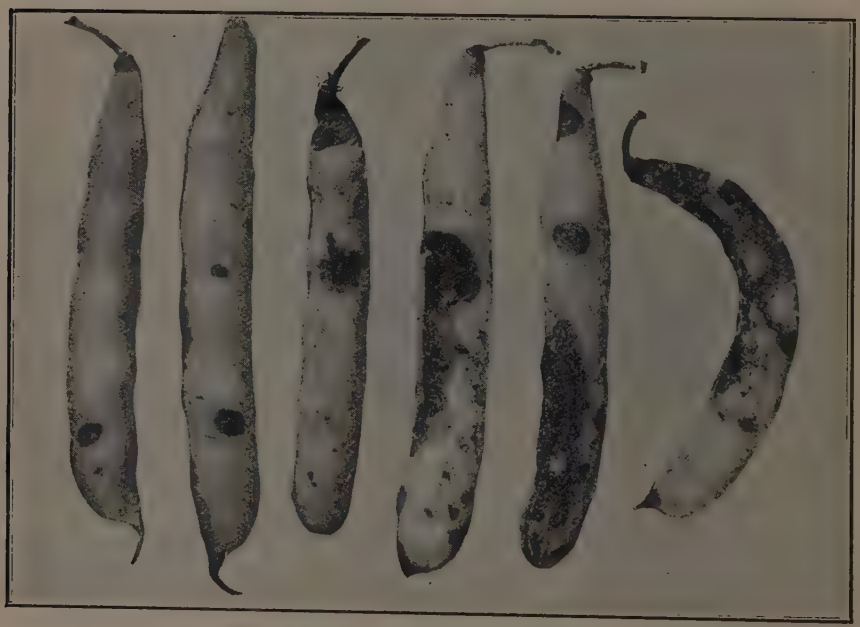


FIG. 4. PODS OF BUTTER BEAN WITH LESIONS PRODUCED IN THE FIELD.

*[Photos by H. Drake.*

proof of the presence of the organism, for similarly stained seed from bulk lines do not always give cultures of the pathogen. Further, it is possible, particularly in coloured varieties, for the seed to be infected without showing any symptom of infection. In immature infected pods bacterial slime is often present between the pod lesion and the underlying seed, and even under the seed testa. In severe cases of seed infection the testa might be broken, the surface of the cotyleden disintegrated, or the seed shrivelled. As noted previously, the causal organism has been isolated from seed underlying pod lesions.

### Morphology.

The organism is a short colourless rod, motile by one to seven polar flagella; flagella often present at both poles, especially in pairs; there is a tendency to develop peritrichiate flagella as an occasional flagellum arises from side of rod; flagella do not stain readily with Gray's or Maneval's stains; size of rod, 0·45–0·55$\mu$ by 0·6–1·7$\mu$ rounded ends; single rods and pairs common; filaments up to 27$\mu$ long in freshly isolated cultures; endospores or capsules not noted; chains greater than two pairs not noted; gram negative; fairly strict aerobe.

### Cultural characteristics.

*Beef peptone agar slopes:* During first few days a scanty colourless growth; later filiform, raised to convex, glistening, smooth, translucent, milky, butryous; medium not changed; no odour; fluorescence not observed. *Beef peptone agar plate:* Similar to beef peptone agar slope; entire edge, 1 mm. diameter in ten days, and 2·5 mm. in four weeks; in four weeks becomes white in middle of colony, and periphery becomes undulate. *Beef peptone broth:* Slight persistent clouding; no odour; no pellicle; small white sediment. *Tryptophane broth:* Slight persistent clouding; no odour; small flocculent surface growth; small white sediment. *Gelatine stab:* Thin dry surface growth; no liquefaction up to nine weeks. *Litmus milk:* Slight change to blue in six days, with persistent definite light blue for at least nine weeks; in seven weeks basal 12 mm. changes to white, to dirty yellow; no other change. *Milk plus brom-thymol blue:* Similar to litmus milk, except blue deeper; in seven weeks basal 12 mm. changes to light yellow. No coagulation or clearing. *Potato slice:* Abundant growth in four days, 4 mm. wide, faint yellow, slimy, moist, glistening; potato becomes grey; in nine weeks no extension of growth, but top third of potato dark brown, and grey below; streak uneven in colour from colourless below to light brown above. *Hydrogen sulphide:* Stab in lead acetate agar; abundant surface growth; $H_2S$ not formed. *Indole:* No indole formed using the Goré test. Starch not hydrolyzed. *Nitrate reduction:* Abundant growth on nitrate media; nitrates not reduced; ammonia not formed. *Fermentation tubes (agar stabs):* Good growth on surface, but no gas in mannitol, dextrine, glucose, lactose, sucrose, raffinose, glycerol, galactose, and maltose. In seven to ten days very slight acid production in raffinose, mannitol, sucrose, glycerol; in same time slightly alkaline in dextrine and lactose; no change in glucose, or galactose; the change in either direction not exceeding pH 0·2.

Note.—In the preparation of culture media and tests the recommendations of the Committee of the Society of American Bacteriologists have been followed, and where possible "Difco" media have been used.

## Identity of the Causal Organism.

Recently Burkholder([4]) discussed the known bacterial diseases of the bean, and in an attempt to differentiate the various causal organisms has considered symptomatology the host range, morphology, and cultural characteristics of each pathogen. This work covers a study of *Phytomonas phaseoli*, *P. phaseoli* var. *fuscans*, *P. flaccumfaciens*, *P. medicaginis* var. *phaseolicola*, *P. vignae* var. *leguminophila*, and *P. viridiflava*.

Comparison of the New Zealand organism with these shows that it most closely resembles *P. medicaginis* var. *phaseolicola*. Symptomatically the two organisms are similar, and separable from the other pathogens, in the production of ooze from stem lesions, a silvery incrustation on pod lesions, and the "halo" condition of leaf lesions. A consideration of the descriptions of morphological and cultural characteristics shows that the New Zealand pathogen again agrees very well with *P. medicaginis* var. *phaseolicola*, though they differ in size, flagellation, and gelatine liquefaction. This resemblance suggests that the New Zealand organism is more closely related to *P. medicaginis*, as originally described by Sackett, than is the variety *phaseolicola*.

Burkholder, in discussing the relation of *P. medicaginis* and the var. *phaseolicola* admits that "these differences are slight, and are ones which would scarcely be used as specific. In the first few cases* they even might be attributed to differences in technique or interpretation." Of these differences he stresses the importance of pathogenicity. But, in my opinion, pathogenicity is not a classificatory character, and as the other differences detailed by Burkholder are uncertain or variable I consider the variety *phaseolicola* to be untenable, and propose that it be treated merely as a form separated from *P. medicaginis* by the fact that it is not pathogenic towards lucerne.

## Control Measures.

As this disease of beans is carried over from one season to the next by infected seed it is evident that there are two possible methods of control: (1) Seed disinfection; (2) use of disease-free seed.

Experience in this Laboratory over the past five years has been such that it is considered impracticable to sterilize satisfactorily fleshy seeds such as peas or beans; and this opinion has been substantiated by work performed elsewhere, since many overseas workers have failed to combat the various bacterial wilts of beans by seed disinfection. Realizing this fact, on the outbreak of bacterial wilt in Marlborough immediate steps were taken to secure lines of seed from disease-free crops, so as to ensure that subsequent sowings would be reasonably free from the disease.

To enable this to become operative, a system of inspection and certification was instigated by the Department of Agriculture. All growing crops were rigorously inspected by Mr. Elliott, and a close record kept of both diseased and clean lines. The latter were again inspected shortly before harvesting, and, if found to be free, were threshed under the supervision of the Instructor, being passed through mills cleaned down and sterilized, and the seed placed in clean bags and immediately sealed. During cleaning operations similar precautions were taken, the plant used for this operation also being cleaned down and sterilized, and the cleaned lines were immediately sealed in new bags, all operations being conducted in the presence of the Instructor.

* Six differences are tabulated, including flagellation and pathogenicity.

In this manner all reasonable precautions were taken to ensure that clean lines were so treated that the danger of infection was reduced to a minimum. Arrangements were made that only seed from these apparently disease-free crops should be sown for seed purposes in the present season, the system of certification now operative providing that only such will be available for certification during the growing season.

Additionally, the certification system requires that such seed shall have been grown on land not previously in beans known to have been infected last season. Naturally, it is not possible to determine at the present stage whether this action will result in the elimination of the disease from New Zealand, since the system has been in operation only during and since last season. Growers may rest assured, however, that every reasonable precaution has been taken by the Department of Agriculture to cope with this problem.

As a safeguard against the possibility of the system failing (a possibility which must be faced, since it is extremely difficult to examine thoroughly any area with sufficient care to be certain that no diseased plants are present) attempts are being made to raise, under isolated conditions, lines of the principal varieties grown in New Zealand. For this purpose lines of selected seed of New Zealand, Australian, and English origin are being grown at the Plant Research Station, and are being subjected to bi-weekly inspections. Should lines be raised in this manner free from bacterial wilt, they will be bulked under similar isolated conditions, and ultimately be distributed for commercial production.

In the meantime growers will aid in the attempt to eradicate this serious disease by observing the following conditions:—

(1) Use only seed which previous inspection has shown to be from apparently clean crops;

(2) Sow only on land which was not in beans the previous season, or on land which carried a crop in which the disease was not detected;

(3) Inspect crops regularly, and notify the Instructor in Agriculture immediately if apparently diseased plants are present.

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# SEED CERTIFICATION.

## SUMMARY OF OPERATIONS DURING SEASON 1930–31.

*(Concluded from last month.)*

Reported by J. W. HADFIELD, Agronomist, and J. H. CLARIDGE, Assistant in Agronomy, Department of Agriculture.

### Seed Potatoes.

One important change in connection with seed-potato certification was introduced during the 1930–31 season. In the past growers were entitled to enter any crop they might desire. It was found that many of these were quite useless, and that the Department was being put to considerable expense in testing these lines and inspecting the crops. It was decided, therefore, that only those lines certified or provisionally certified either the preceding season or the season before would be eligible for entry; any other lines or new varieties which growers might desire to enter would first have to pass a qualification trial. In 1929–30 season 397 crops were entered, and during the 1930–31 season 364 were entered for certification and 218 for the qualification trials, making a total of 582 crops. This represents a very considerable advance.

The severe slump in potato values has considerably affected the 1931 harvest. The price of ordinary table and seed has reached the lowest price on record, and this reacted on the sale of certified seed.

The certification position is summarized in Table 12.

*Table 12.—Seed Potatoes: Entries and Inspections, Season 1930–31.*

(Figures in parentheses refer to season 1929–30; this applies to all tables where such figures occur.)

| —— | Number. | Percentage. | Acreage. |
|---|---|---|---|
| Crops entered | 364 (397) | .. | .. |
| Crops withdrawn | 17 (34) | .. | .. |
| Crops inspected | 347 (363) | .. | 1,334 (1,200) |
| Crops rejected on account of rogues | 23 (84) | 6·6 (23·5) | 83 |
| Crops rejected on account of virus and low cropping-power | 84 (151) | 25·3 (54·2) | 290 |
| Crops provisionally certified | 240 (128) | 69·2 (35·3) | 950 (590) |
| Average size of areas passed | .. | .. | 4 (4·6) |

The table shows a very definite advance in the quality of crops entered. Despite the raising of standards the percentage rejected for rogues has fallen from 23·5 per cent. to 6·6 per cent., and rejections for virus diseases and cropping-power from 54·2 per cent. to 25·3 per cent. The percentage provisionally certified has risen from 35·3 per cent. to 69·2 per cent.

Table 13 shows the distribution of all lines according to district of origin.

In Table 14 the chief varieties are listed and reasons for rejection recorded against each individual variety. Arran Chief has not only

*Table 13.—Seed Potato Crops provisionally certified or rejected, arranged according to District of Origin.*

| District. | Inspected. | | Rejected. | | | | Provisionally certified. | |
|---|---|---|---|---|---|---|---|---|
| | | | For Rogues. | | For Virus and Cropping-power. | | | |
| | Crops. | Acreage. | Crops. | Acreage. | Crops. | Acreage. | Crops. | Acreage. |
| Manawatu .. | 10 | 42½ | 1 | 1 | 2 | 3 | 7 | 38½ |
| Wairarapa .. | 1 | 1 | .. | .. | .. | .. | 1 | 1 |
| Marlborough .. | 3 | 12 | .. | .. | 2 | 3 | 1 | 9 |
| North Canterbury | 197 | 855 | 13 | 62½ | 41 | 129½ | 143 | 653 |
| Mid-Canterbury .. | 54* | 189½ | .. | .. | 12 | 47 | 42* | 142½ |
| South Canterbury | 56 | 168½ | 5 | 13 | 22 | 89½ | 29 | 66 |
| North Otago .. | 3 | 6 | 1 | 1 | 1 | 4 | 1 | 1 |
| Otago .. .. | 9 | 30 | 3 | 6 | 3 | 12½ | 3 | 11½ |
| Southland .. | 14 | 29½ | .. | .. | 1 | 2 | 13 | 27½ |
| Total .. | 347 | 1,334 | 23 | 83½ | 84 | 290½ | 240 | 950 |

* Includes twenty-five lines entered by the Ashburton Experimental Farm.

The chief causes for rejection may be stated as being the presence of rogues and degeneration or lack of cropping-power induced by virus disease.

*Table 14.—Potato Certification, 1930–31: Reasons for Rejection arranged according to Varieties.*

| Variety. | Number of Lines inspected for Foreign Varieties. | Percentage rejected for Foreign Varieties. | Number of Lines inspected for Virus and Low Cropping-power. | Percentage rejected for Virus and Low Cropping-power. | Number of Lines provisionally certified. | Percentage of Crops provisionally certified on Crops inspected. |
|---|---|---|---|---|---|---|
| Aucklander Short-top | 108 | 4·6 | 103 | 22·3 | 80 | 74·1 |
| | (61) | (26·2) | (45) | (37·8) | (28) | (45·9) |
| Dakota .. .. | 92 | 2·2 | 90 | (35·5) | 58 | 63·0 |
| | (97) | (20·6) | (77) | (55·8) | (34) | (35·1) |
| Aucklander Tall-top | 34 | 11·8 | 30 | 16·6 | 25 | 73·7 |
| | (18) | (16·7) | (15) | (33·3) | (10) | (55·6) |
| Arran Chief .. | 20 | 35·0 | 13 | 61·5 | 5 | 25·0 |
| | (54) | (61·2) | (21) | (76·3) | (5) | (9·3) |
| King Edward .. | 17 | .. | 17 | 17·6 | 14 | 82·3 |
| | (19) | (10·5) | (17) | (41·2) | (10) | (52·6) |
| Bresee's Prolific .. | 14 | 21·4 | 11 | 27·3 | 8 | 57·2 |
| | (14) | (14·3) | (12) | (41·7) | (7) | (50·0) |
| Epicure .. .. | 10 | .. | 10 | 10·0 | 9 | 90·0 |
| | (13) | | (13) | (53·8) | (7) | (46·2) |
| Up-to-date .. | 7 | .. | 7 | 28·6 | 5 | 71·5 |
| | (16) | (12·5) | (14) | (78·7) | (3) | (18·8) |
| Iron Duke .. | 7 | 14·3 | 6 | .. | 6 | 85·7 |
| | (7) | (71·4) | (2) | (50·0) | (1) | (14·3) |
| Early Regent .. | 7 | .. | 7 | 42·8 | 4 | 57·2 |
| | (3) | | (3) | (33·3) | (2) | (66·7) |
| Majestic .. .. | 3 | .. | 3 | .. | 3 | 100·0 |
| | (9) | | (9) | (77·8) | (2) | (22·2) |
| Total or average of all varieties | 347 | 6·6 | 324 | 25·3 | 240 | 69·2 |
| | (363) | (23·5) | (279) | (54·2) | (128) | (35·3) |

the highest percentage of rejections for rogues, but also for virus. Dakota, on the other hand, has few rogues, but a high proportion of the crops are rejected for virus.

The steady progress that has been maintained since the inauguration of potato certification is shown in Table 15. This gives not only the range of varieties entered, but also the number of crops and acreage provisionally certified in each season from 1927–28 to 1930–31.

*Table 15.—Potato Certification: Number of Crops and Areas Provisionally Certified, 1927–28 to 1930–31.*

| Variety. | Number of Crops. | | | | Acreage. | | | |
|---|---|---|---|---|---|---|---|---|
| | 1927–28. | 1928–29. | 1929–30. | 1930–31. | 1927–28. | 1928–29. | 1929–30. | 1930–31.† |
| Aucklander Short-top | 7 | 11 | 26 | 80 | 75 | 67 | 96 | 297½ |
| Dakota | 11 | 12 | 27 | 58 | 121 | 81 | 132 | 270½ |
| Aucklander Tall-top | 5 | 4 | 8 | 25 | 30 | 17 | 56 | 86 |
| King Edward | .. | 1 | 9 | 14 | .. | 2 | 25 | 30½ |
| Epicure | 5 | 6 | 5 | 9 | 13 | 15 | 29 | 55½ |
| Bresee's Prolific | 10 | 4 | 7 | 8 | 106 | 54 | 78 | 106½ |
| Iron Duke | .. | .. | 1 | 6 | .. | .. | 12 | 23½ |
| Arran Chief | 4 | 9 | 3 | 5 | 36 | 54 | 6 | 17½ |
| Up-to-date | 3 | 5 | 2 | 5 | 13 | 20 | 3 | 11 |
| Early Regent | 1 | 2 | 2 | 4 | 35 | 23 | 4 | 6 |
| Majestic | .. | 2 | 2 | 3 | .. | 6 | 11 | 12 |
| Early Rose | .. | .. | .. | 3 | .. | .. | .. | 4 |
| Endurance | 1 | 3 | 1 | 3 | 1 | 4 | 3 | 7½ |
| Field Marshal | .. | 1 | 1 | 2 | .. | 7 | 5 | 7 |
| Great Scot | .. | 2 | 1 | 2 | .. | 2 | 4 | 4 |
| Kerr's Pink | .. | .. | .. | 2 | .. | .. | .. | 1 |
| Ally | .. | .. | .. | 2 | .. | .. | .. | 2 |
| Robin Adair | 2 | .. | 1 | 2 | 6 | .. | 3 | 8 |
| Golden Wonder | .. | 2 | 1 | 1 | .. | 4 | 1 | * |
| Arran Banner | .. | .. | .. | 1 | .. | .. | .. | * |
| Abundance | .. | .. | .. | 1 | .. | .. | .. | * |
| Arran Consul | .. | .. | .. | 1 | .. | .. | .. | * |
| British Queen | .. | .. | .. | 1 | .. | .. | .. | * |
| Sharpe's Express | .. | .. | .. | 1 | .. | .. | .. | * |
| Duke of York | .. | .. | .. | 1 | .. | .. | .. | * |
| Northern Star | 1 | 1 | 8 | .. | 35 | 12 | 17 | .. |
| Brownell's Beauty | .. | 1 | 1 | .. | .. | 1 | 3 | .. |
| Maori Chief | .. | .. | 1 | .. | .. | .. | 2 | .. |
| North Downs | .. | .. | 1 | .. | .. | .. | 2 | .. |
| Total | 50 | 66 | 108 | 240 | 471 | 369 | 492 | 950 |
| Average areas | .. | .. | .. | .. | 9·4 | 5·5 | 4·6 | 4·0 |

* Small areas from Ashburton Experimental Farm.

† As the second field inspection was omitted in 1930–31 this column shows crops which passed in purity and cropping-power. In the previous years some crops were not issued with provisional certificates owing to the presence of tuber diseases.

In the qualification trials the samples submitted are grown and the varietal purity and cropping-power determined. The entries are then grouped into three classes. Class A are those lines which are recommended for entry in certification. Group B contains those which are on the border-line, and which the grower may or may not enter as he feels disposed. In Group C are placed those lines

which are definitely of no value for purposes of certification. Table 16 shows the origin and classification of lines entered in the qualification trials.

*Table 16.—Seed Potato Qualification Trials in 1930–31, showing Classification and Origin of Lines.*

| District of Origin. | Number of Varieties. | Number of Entries. | Percentage of Entries classified as | | | | |
|---|---|---|---|---|---|---|---|
| | | | Class A. | Class B. | Class C. | Too mixed to judge. | Insufficient Commerical Importance. |
| Hawke's Bay – Manawatu | 3 | 5 | 20·0 | 20·0 | 40·0 | .. | 20·0 |
| North Canterbury | 36 | 132 | 24·2 | 18·2 | 38·6 | 12·9 | 6·1 |
| Mid-Canterbury .. | 4 | 11 | 54·5 | .. | 27·3 | 18·2 | .. |
| South Canterbury .. | 21 | 48 | 4·2 | 6·2 | 64·6 | 14·6 | 10·4 |
| Otago .. .. | 4 | 8 | .. | 25·0 | 25·0 | 50·0 | .. |
| Southland .. | 6 | 14 | 28·6 | 35·8 | 7·2 | 14·2 | 14·2 |
| Totals or averages | 52 | 218 | 20·6 | 16·1 | 41·3 | 14·7 | 7·3 |

A wide range of varieties has been entered in the qualification trials, and a complete list is shown in Table 17. As indicated, a proportion of entries were so mixed as to render worthless the trial of that particular line. There are also enumerated certain varieties which, despite a satisfactory yield in certain instances, are not considered of sufficient economic importance. This might be because they have certain undesirable features, or because sufficient stocks are not available to warrant their inclusion in certification. Many of the other varieties would also be excluded as of insufficient economic value had they not been already rejected for other reasons.

*Table 17.—Seed Potato Qualification Trials in 1930–31, showing Classification of Lines and Range of Cropping-power.*

| Variety. | Number of Entries. | Classification of Entries. | | | | | Range of Cropping-power in Tons per Acre. |
|---|---|---|---|---|---|---|---|
| | | Class A. | Class B. | Class C. | Too mixed to judge. | Insufficient in Commercial Importance. | |
| Aucklander Short-top .. .. | 42 | 16 | 8 | 15 | 3 | .. | 9·9 – 2·8 |
| Arran Chief .. .. | 20 | 3 | 2 | 3 | 12 | .. | 8·7 – 4·2 |
| Dakota .. .. .. | 19 | 4 | 1 | 11 | 3 | .. | 9·4 – 3·6 |
| Northern Star .. .. .. | 14 | .. | 3 | 11 | .. | .. | 7·4 – 2·0 |
| Aucklander Tall-top .. .. | 12 | 8 | 1 | 1 | 2 | .. | 10·4 – 4·0 |
| King Edward .. .. .. | 11 | 2 | 3 | 6 | .. | .. | 8·0 – 1·3 |
| Up-to-date .. .. .. | 10 | 4 | 4 | 2 | .. | .. | 10·0 – 5·7 |
| Epicure .. .. .. | 9 | 2 | .. | 6 | 1 | .. | 5·0 – 2·2 |
| Bresee's Prolific .. .. | 7 | 1 | 5 | 1 | .. | .. | 8·5 – 5·4 |
| Early Rose .. .. .. | 6 | .. | 1 | 2 | 3 | .. | 5·1 – 2·9 |
| Jersey Bennes .. .. .. | 5 | .. | 1 | 4 | .. | .. | 4·8 – 0·7 |
| Robin Adair .. .. .. | 5 | .. | .. | 5 | .. | .. | 5·5 – 3·8 |
| Field Marshal .. .. .. | 4 | .. | 3 | 1 | .. | .. | 8·2 – 6·7 |
| Majestic .. .. .. | 4 | 1 | .. | 2 | 1 | .. | 7·5 – 0·8 |
| Great Scot .. .. .. | 4 | 1 | .. | 3 | .. | .. | 7·6 – 1·6 |
| Arran Victory .. .. .. | 3 | .. | 1 | 2 | .. | .. | 7·1 – 4·1 |

*Table 17*—continued.

| Variety. | Number of Entries. | Classification of Entries. | | | | | Range of Cropping-power in Tons per Acre. |
|---|---|---|---|---|---|---|---|
| | | Class A. | Class B. | Class C. | Too mixed to judge. | Insufficient in Commercial Importance. | |
| Early Perfection .. .. | 3 | .. | .. | .. | .. | 3 | 3·9 – 3·3 |
| New Era .. .. .. | 2 | .. | .. | .. | .. | 2 | 7·8 – 7·0 |
| Iron Duke .. .. .. | 2 | .. | .. | 1 | 1 | .. | 5·7 |
| Snowflake .. .. .. | 2 | .. | .. | .. | .. | 2 | 7·3 – 6·9 |
| Golden Wonder .. .. | 2 | .. | .. | .. | .. | 2 | 5·3 – 5·0 |
| Endurance .. .. .. | 2 | 1 | .. | .. | 1 | .. | 10·6 |
| Maori Chief .. .. .. | 2 | .. | .. | 2 | .. | .. | 5·1 – 3·7 |
| Gold Coin .. .. .. | 2 | .. | .. | 1 | 1 | .. | 3·9 |
| Early Puritan .. .. .. | 2 | .. | .. | 1 | 1 | .. | 3·6 |
| Early Regent (bolter) .. .. | 1 | 1 | .. | .. | .. | .. | 7·0 |
| Windsor Castle .. .. | 1 | 1 | .. | .. | .. | .. | 10·7 |
| Carter's Phoenix .. .. | 1 | .. | .. | .. | 1 | .. | 8·1 |
| Arran Roseberry .. .. | 1 | .. | .. | 1 | .. | .. | 1·5 |
| Cliff's Kidney .. .. .. | 1 | .. | .. | 1 | .. | .. | 3·7 |
| Acme Kidney .. .. .. | 1 | .. | .. | .. | .. | 1 | 5·8 |
| Red Beauty .. .. .. | 1 | .. | .. | 1 | .. | .. | 2·5 |
| American Wonder .. .. | 1 | .. | .. | .. | .. | 1 | 6·7 |
| Catriona .. .. .. | 1 | .. | .. | .. | .. | 1 | 3·6 |
| Arran King .. .. .. | 1 | .. | .. | 1 | .. | .. | 1·1 |
| Sunrise .. .. .. | 1 | .. | .. | 1 | .. | .. | 1·5 |
| Witchhill .. .. .. | 1 | .. | .. | 1 | .. | .. | 1·5 |
| Tasmanian Brownell's .. .. | 1 | .. | 1 | .. | .. | .. | 6·9 |
| Arran Comrade .. .. | 1 | .. | .. | .. | .. | 1 | 3·1 |
| Burbank .. .. .. | 1 | .. | .. | 1 | .. | .. | 2·9 |
| White Rock .. .. .. | 1 | .. | .. | .. | 1 | .. | .. |
| Eclipse .. .. .. | 1 | .. | .. | .. | 1 | .. | .. |
| Arran Banner .. .. .. | 1 | .. | 1 | .. | .. | .. | 7·1 |
| Black Kidney .. .. .. | 1 | .. | .. | .. | .. | 1 | 3·2 |
| Delaware .. .. .. | 1 | .. | .. | 1 | .. | .. | 2·4 |
| Sharpe's Express .. .. | 1 | .. | .. | 1 | .. | .. | 3·0 |
| No. 1 .. .. .. | 1 | .. | .. | 1 | .. | .. | 5·5 |
| Sutton's 26 .. .. .. | 1 | .. | .. | .. | .. | 1 | 5·0 |
| Sir J. G. Wilson .. .. | 1 | .. | .. | .. | .. | 1 | 9·5 |
| Total .. .. .. | 218 | 45 | 35 | 90 | 32 | 16 | 10·7 – 0·7 |
| Percentage in each class .. | .. | 20·6 | 16·1 | 41·3 | 14·7 | 7·3 | .. |

## Seed Beans.

Seed beans are grown fairly extensively in Marlborough, and the discovery that certain crops were infected with bean-wilt called for immediate action to prevent the distribution of infected seed and preserve the present export trade. All crops were therefore inspected in the field, and the produce of clean crops sealed at threshing and machine-dressed under supervision. The seed was sealed and tagged as being the produce of areas in which no wilt could be found.

Altogether 94 crops were inspected in the field, and of this number 68 crops (180 acres) passed field inspection, and 26 crops (138 acres) were rejected on account of the presence of bean-wilt. Of the 68 crops passed the produce of 62 has been sealed and branded in the paddock up to date of writing, while about 90 per cent. of this seed has been machine-dressed and finally tagged. Table 18 sets out the quantity of seed harvested and machine-dressed

*Table 18.—Seed Bean Certification : Paddock Sealing and Machine-dressing Returns, 1930–31.*

| Type. | Acreage harvested. | Number of Sacks sealed in Paddock. | Number of Bushels into Machine-dresser. | Number of Bushels out of Machine-dresser. | Percentage of Loss in Dressing. | Yield per Acre of Machine-dressed Seed. |
|---|---|---|---|---|---|---|
| | | | | | | Bushels. |
| Canadian Wonder | 79 | 288 | 868·7 | 664·7 | 23·4 | 9·3 |
| Butter .. | 24 | 91 | 283·9 | 189·1 | 33·3 | 8·3 |
| Runner .. .. | 11 | 39 | 106·6 | 82·0 | 22·9 | 8·5 |
| Miscellaneous .. | 19 | 69 | 194·6 | 148·9 | 23·3 | 9·4 |
| Totals or averages | 133 | 487 | 1,453·8 | 1,084·7 | 25·3 | 9·0 |

## DORMANCY PERIOD OF THE CITRUS BARK-BLOTCH ORGANISM.

WITH regard to the pathogenicity of the bark-blotch organism (*Ascochyta corticola*), it was stated in an article in this *Journal* for May, 1931, that infection may become established through injuries and the lesion remain dormant until conditions become favourable, when further development proceeds. Subsequent to the publication of that article, continued observations have shown that a dormancy period of eleven to fifteen months may elapse after inoculation, when, given favourable conditions, the disease is capable of breaking out in a severe form.

One lemon-tree of the Lisbon variety was inoculated at four points on 11th July, 1930, but no cankers were produced from these inoculations, only small brown lesions ¼ in. in diameter being formed. There was no further development of these lesions until about the middle of October, 1931, when three cankers were observed at the original points of inoculation, one having already ringbarked the stem. A second Lisbon tree was inoculated on 17th November, 1930, and on examination four months later showed similar lesions. No further development was observed until eleven months had elapsed, when a canker appeared round one of the original points of inoculation, the main stem and two laterals being killed outright.

This period of dormancy has a practical significance, for when cankers have been treated and sterilized the absence of subsequent spread cannot be taken as an indication that the process has been successful, since there is a possibility of the fungus remaining dormant though viable. Consequently growers will be well advised to inspect at intervals over a period of eighteen months all treated cankers, in order to ensure that the treatment has been successful.

*—R. M. Brien, Mycological Laboratory, Plant Research Station.*

*Correction.*—Referring to last month's article, "Investigations in Pasture Production," slight errors occurred in the figures given in the last sentence of the first paragraph of page 322. These should read "19·4, 18·6, and 18·85 per cent.," instead of "19·2, 18·8, and 18·9 per cent."

# PUWERA GUM-LAND EXPERIMENTAL FARM.

## NOTES ON OPERATIONS, SEASONS 1929–30 AND 1930–31.

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### PASTURE ESTABLISHMENT AFTER SURFACE CULTIVATION.

THE usual practice when sowing gum-land direct to grass has been to plough, and then to fallow for six or nine months before working down for grass-seed sowing. The long fallow of ploughed land has proved necessary to allow of the adequate weathering and aeration of the soil for the preparation of a good seed-bed.

By breaking down the furrow slices with the disks before they have time to dry out and bake hard in the early summer, the weathering and aeration can be considerably assisted by subsequent summer cultivation, and the land is the more easily prepared for sowing early in the autumn, this being another essential to good pasture establishment. However, even with a long fallow and summer working, the initial pasture establishment is often poor on ploughed gum-land, owing to the fact that only the top inch or so of virgin land contains any humus, and the seed-bed prepared by ploughing often consists of clay almost devoid of humus.

Attempts have been made from time to time to conserve this darker surface layer of gum-land for a seed-bed by carrying out surface cultivation with the disks and harrows—generally with the aim of establishing a temporary pasture of Lotus hispidus—but the practice has up to recently never seriously competed with ploughing.

During the early years of breaking in at Puwera Farm some surface-cultivation work for pasture establishment was carried out in Field 8, but no further work was done in this direction until two years ago, when a rough area of some 12 acres was sown in the autumn of 1929 after being surface-cultivated. The soil on this area was lighter than that of most of the farm, and few gum-holes had been dug in it. The aim of this cultivation work was to establish a temporary pasture as a preparation of the land for later ploughing and sowing to permanent grass; at the same time it gave an opportunity to study the relative establishment of the different species included in the mixture.

The surface covering consisted of heavy manuka and flax (phormium) on a small area of flat land, dense 4 ft. to 5 ft. manuka and wiwi rush on the lower slopes, scattered manuka, gorse, and short bracken fern on the higher ground, with wiwi rush in wet places. The manuka was cut as close to the ground as possible during the summer, and in February by systematic firing the manuka, fern, and wiwi rush were burnt off, leaving a hard, dry, but comparatively clean surface. Only two horses were available for cultivation work, and, as light disks would not penetrate the surface, the land was worked up with the Whakatane harrows, a satisfactory but shallow seed-bed being obtained, with five or six strokes.

The grass-seed, a light mixture of 19 lb. per acre—comprising perennial rye-grass, Italian rye, crested dogstail, cocksfoot, brown-top, white clover, and Lotus hispidus—was sown in March with 2 cwt. per acre of superphosphate. The strike was good, but the early grass-growth was rather poor, except on areas where the manuka had been heavy and a good ash covering was left after the burn. In August a dressing of sulphate of ammonia was applied at the rate of 1 cwt. per acre on half the area, and ½ cwt. on the remainder. The fertilizer gave a rapid improvement in the colour and growth, particularly on the area which received 1 cwt. per acre. In the first spring there was a tendency for Lotus hispidus to smother out the other species, but the establishment and growth of perennial rye-grass and white clover was thick enough to prevent much reseeding of the manuka. Dense patches of gorse seedlings have, however, developed from original isolated clumps. These are being kept in check by mowing.

### OTHER EXPERIENCE.

Details of some interesting work in connection with the surface cultivation of somewhat similar land on the property of Wilson's Portland Cement Co., near Whangarei, have been made available to the writer by the manager. Here the aim has been to establish as quickly as possible permanent pastures with perennial rye and white clover as the dominant species until paspalum comes in to take a part in the sward. The original manuka covering is cut in the spring and early summer and burnt about January or February.

In the preparation of the first area of about 100 acres the disks were used, and, though a good deal of hard work was necessary to clear the ground for the cultivation, a satisfactory seed-bed was obtained. A wet summer permitted much more effective work being done with the disks than is usually the case at this time of the year, and an early sowing was possible. A permanent-pasture seeding of 40 lb. per acre, including 20 lb. of perennial rye, together with 5 cwt. to 6 cwt. per acre of a mixture of basic slag and superphosphate, has given a good sole of grass, dense enough to prevent re-establishment of manuka seedlings. Gorse seedlings from scattered plants have appeared, but have been effectively dealt with by heavy stocking with sheep. Perennial rye and white clover were well established at the end of the second year, and the pasture has given good feed since the first autumn. Sulphate of ammonia, either alone or combined with phosphate in the form of ammoniated super, has been used to great advantage as an early spring dressing of young pastures on the property, particularly in the strengthening of the perennial rye. This dressing has allowed for exceptionally heavy stocking with sheep in the early spring.

For the cultivation of a further area burnt and cleared during last summer, a special swamp harrow of the triangular railway iron type and fitted with special tynes was made. In view of the necessity of getting the seed-bed prepared early in March this special harrow has several advantages over the disks. It has better penetration on a hard dry surface, it works well amongst stumps and sticks, it can be used as a leveller for filling in all but the

deepest gum-holes, and can stand up to the roughest work without breakage. On an area of about 30 acres prepared with four to five strokes of the swamp harrow, giving a well-worked seed-bed to a depth of 2 in. to 2½ in., a very good strike of perennial rye and clovers was secured from a sowing in March. The surface cultivation of a further area was delayed until it was possible to use the disk harrows effectively, and, although a better seed-bed was prepared with the two implements, the initial strike and growth of the earlier sowing have been much better than those secured on the area where the sowing was delayed until towards the end of April. It is only in occasional seasons that the disks can be used for the surface cultivation of dry clay-lands sufficiently early in the autumn to allow of the sowing of grass-seed at the right time to give this grass a chance to become well established before the land is too cold and wet for growth.

It would appear from this work on the property of the Portland Cement Co. that, providing the tractive power were available, much of the initial levelling and summer cultivation of dug-over gum-land could be done with similar implements to those mentioned.

## Pasture Top-dressing Experiments.

### NITROGENOUS FERTILIZERS.

Experimental work in connection with the use of nitrogenous fertilizers—sulphate of ammonia and Nitrochalk—in promoting early grass-growth has been continued during the past two seasons. Eight fields, having a total area of 22 acres, were used for the purpose. Half the fields were dressed with nitrogen in addition to the phosphates, while the control fields received phosphatic dressings only.

*Table showing Results from Nitrogen Grazing Trials.*

| Field No. | Treatment. | Cow-days per Acre. | Dry-stock Days per Acre. | Butterfat per Acre. |
|---|---|---|---|---|
| | 1929–30 Season (1st July to 30th June). | | | lb. |
| 1 | Sulphate of ammonia .. | 327 | 18 | 187 |
| 2 | Phosphate .. .. .. | 234 | 5 | 135 |
| 3 | Nitrochalk .. .. .. | 271 | 27 | 154 |
| 4 | Phosphate .. .. .. | 302 | 16 | 165 |
| 5 | Sulphate of ammonia .. | 320 | 16 | 176 |
| 6 | Phosphate .. .. .. | 304 | 15 | 186 |
| 7 | Sulphate of ammonia .. | 305 | 14 | 181 |
| 8 | Phosphate .. .. .. | 202 | 9 | 119 |
| | 1930–31 Season (1st July to 30th June). | | | |
| 1 | Sulphate of ammonia .. | 384 | 27 | 238 |
| 2 | Phosphate .. .. .. | 222 | 10 | 166 |
| 3 | Nitrochalk .. .. .. | 310 | 26 | 213 |
| 4 | Phosphate .. .. .. | 257 | 11 | 173 |
| 5 | Sulphate of ammonia .. | 284 | 14 | 194 |
| 6 | Phosphate .. .. .. | 300 | 10 | 202 |
| 7 | Sulphate of ammonia .. | 330 | 14 | 210 |
| 8 | Phosphate .. .. .. | 185 | 15 | 110 |

NOTE.—Cow-days per acre = number of cows grazed × number of days ÷ number of acres; dry-stock days are similarly calculated.

In the 1929-30 and 1930-31 seasons the phosphates applied to all the fields consisted of 2 cwt. basic slag in the autumn and 2 cwt. superphosphate in the late spring. Three dressings of nitrogenous manures, each of 1 cwt. per acre, were given in the 1929-30 season—one in July, one in October, and another in March. In the 1930-31 season only one dressing of 2 cwt. per acre was given in July. No particular advantage was shown for the October and March dressings of nitrogen. Grazing records were kept for each field in the trials, and the results are shown in the accompanying table.

### LIME AND POTASH ADDITIONS.

In conjunction with the foregoing experiments small plots were established in May, 1929, to determine whether a possible deficiency of potash or lime might be limiting the effectiveness of the nitrogenous fertilizers applied. Duplicate plots, each 1 chain square, were marked out on each paddock, two of which have been top-dressed with phosphates alone and two with nitrogen in addition to the phosphates. Each plot was dressed with ground carbonate of lime at the rate of 25 cwt. per acre, and on half the plot 2 cwt. per acre of 30 per cent. potash salts was applied in addition to the lime. No further lime has been applied, but the potash dressing was repeated in June, 1930, and again this year.

In three of the paddocks the pasture was in fair heart, with perennial rye dominant, white clover, cocksfoot, and crested dogs-tail; in the fourth paddock, cocksfoot was dominant, with less white clover. A good response had been given to nitrogenous manuring, with a definite increase in the amount of rye-grass particularly.

Since the application of lime and potash the paddocks have been rotationally grazed and the plots inspected at frequent intervals. Up to the end of the first year no noticeable change in the composition of the sward had taken place on any of the plots. No difference in the colour and growth of the plots compared with the rest of the paddocks was noticed, and stock did not show any preference for either the lime or potash treatments. During the second year the potash treatment on the cocksfoot-dominant pasture commenced to show up in better white-clover growth and darker colour, while the potash treatment on one of the other plots also showed an improvement. This plot was under somewhat drier conditions than the others. The liming has as yet made no improvement.

### OBSERVATIONAL TRIALS WITH PHOSPHATE AND LIME.

A series of five small observational top-dressing trials were set out in October, 1929, on Fields 22 and 23. Each trial consisted of nine parallel plots 7 ft. wide by ½ chain long. The trials include annual dressings of superphosphate, 3 cwt. per acre; basic slag, 3 cwt.; Phosfull, 3 cwt.; super, 3 cwt., plus lime, 3 cwt.; super-phosphate, 3 cwt., plus lime (1 ton every four years); and a mixture of equal parts of super and basic slag at 3 cwt. per acre. There were also three check plots receiving no manure. The small plots allow of a better selection of an even sward to start with, and also, since the plots are close together, they all come under the eye at once, and a better comparison can be made between the different

treatments than where larger plots are used. Three plots were established on Field 22, where the sward varies slightly, but in general consists of brown-top dominant, crested dogstail, Lotus hispidus, suckling clover, and a little perennial rye, paspalum, white and red clovers, with a fair amount of bare ground. The sward in Field 23, where two plots were put down, comprised perennial rye, white clover, paspalum, crested dogstail, Lotus hispidus, with red clover and subterranean clover in places. There was little bare ground.

Regular observation of these plots at all stages of growth during the past two seasons showed very distinct differences in the response to the various fertilizers used. Two treatments gave an outstanding improvement in colour, growth, change of sward, and better cover up to the end of the first year. These were superphosphate 3 cwt. plus lime 1 ton, and the mixture of super and basic slag at 3 cwt. Generally the super plus lime 1 ton gave a better growth of rye-grass. Both these treatments showed up at the end of four months, and have continued to improve the sward to a greater extent than any of the others. Super 3 cwt. plus lime 3 cwt. showed more improvement than either super 3 cwt., basic slag 3 cwt., or Phosfull 3 cwt., up to the end of June, 1930. Phosfull showed least general improvement over the check plots. During 1930–31, though the super plus lime 1 ton plots and superphosphate - basic slag mixture continued generally to show most improvement, the superphosphate plots commenced to show out among the other treatments towards the late spring, particularly in the growth of annual clovers in Field 22 and perennial rye in Field 23. The relative improvement for straight superphosphate compared with super 3 cwt. plus lime 3 cwt., basic slag, and Phosfull treatments was maintained, though basic slag and Phosfull tended to show up in comparison in the autumn and winter. The top-dressing will be continued for several seasons, and there is no doubt that this type of small plot offers a cheap and effective means of comparing different fertilizers.

### OBSERVATIONAL TRIALS WITH POTASH AND NITROGEN ON PHOSPHATES AND LIME.

On Field 22 a second series of plots were established at the same time as the foregoing trials. Seven strips, each ½ chain wide by 5 chains long, were set out. The treatments comprised superphosphate 3 cwt. plus lime 1 ton; super 3 cwt. plus lime 3 cwt.; super, 3 cwt.; basic slag, 3 cwt.; Phosfull, 3 cwt.; and basic slag and super, half and half, 3 cwt. per acre; also a check strip with no manure. Across these treatments duplicate plots each ½ chain by 3½ chains were set out and the following dressings applied: 30-per-cent. potash salts, 2 cwt. per acre; sulphate of ammonia, 1 cwt. per acre; sulphate of ammonia 1 cwt., plus 30-per-cent. potash salts 2 cwt., per acre; and check strips with no manure.

Regular inspections showed in the case of the phosphate and phosphate plus lime dressings similar variations to those which occurred in the small plots, but accurate comparisons were difficult to make on account of the size of the plots and the effect of the

cross dressings. In the first year the cross treatments showed a definite improvement in colour, and in clover-growth where potash alone was applied; a marked improvement in colour and rye-grass growth for nitrogen alone; and a still more marked improvement, with a better balance of rye-grass and white clover, where potash and nitrogen were combined.

A second application of fertilizers was made in June, 1930, and a further improvement in the proportion of perennial rye was shown for the sulphate of ammonia dressing, while there was little change in so far as the other treatments were concerned. A further application of fertilizers was made in March, 1931, and the trials are being continued. The very small amount of white clover and perennial rye, which had apparently survived from the original sowing in this field, has militated against a rapid improvement of the sward by such fertilizers as superphosphate and sulphate of ammonia.

### SUMMARY OF TOP-DRESSING RESULTS.

Though as yet no definite conclusions can be drawn from the various observational top-dressing trials, which are being continued for several seasons, the trials so far indicate a relation between the age of the pastures, previous top-dressing, and composition of the sward, with the action of nitrogen, lime, and potash.

(1) Nitrogen in the form of sulphate of ammonia has given best results where the sward was dominantly rye-grass, but has also improved the growth and proportion of rye more than any of the other manures tried on the poorer pastures.

(2) Heavy applications of lime, while giving little or no response in the first two years on well-phosphated pastures in fairly good heart, have shown a marked improvement in four months on younger pastures.

(3) Potash, in the form of 30-per-cent. potash salts at the rate of 2 cwt. per annum, has given a slight but definite immediate response on the poorer pastures, but where regular phosphatic top-dressing has given a good sward it has taken two seasons for the potash treatment to show up in four plots out of eight.

(4) Of the phosphates tried the mixture of super and basic slag in equal parts has proved outstanding on the younger and more open pastures, comparing very favourably in actual results with super 3 cwt. plus lime 1 ton.

(5) The present indications are that both potash and lime could have been replaced with advantage by extra phosphate in the form of either the superphosphate - basic slag mixture or even superphosphate; also that, when used intelligently on the clay gumlands in conjunction with adequate phosphate top-dressing, nitrogen is more effective than either lime or potash in improving the growth and composition of the pastures.

## Rye-grass and Red Clover Investigation.

In conjunction with the work at present being carried out at the Plant Research Station, Palmerston North, a series of twenty-five duplicate plots covering an area of 1 acre were set out in

Field 15, and sown in March, 1930, with nineteen different lines of perennial rye-grass and six lines of red clover, a comparison being made of their relative growth and persistence on the pipeclay soils. The perennial ryes comprised commercial lines of known origin from Hawke's Bay, Poverty Bay, Sandon, Marlborough, South Canterbury, Canterbury, Southland, and Maniototo; the red clovers included samples of Marlborough, Montgomeryshire, English late red, Swedish, and Chilean.

At the end of the first year the rye-grass plots exhibited a striking variation in the proportion of plants which had survived. Whereas the true perennial type of plant with a dense crown, upright growth habit, and many tillers, had no difficulty in standing up to the dry summer conditions, practically all the annual and false perennial types with loose open crowns and sprawling growth-form have died out, leaving the plots with a high percentage of this type of plant practically devoid of rye-grass. In addition, the autumn, winter, and early spring growth was much better on the plots showing a good proportion of true perennial plants.

Of the lines sown, the Hawke's Bay, Poverty Bay, and Sandon, have given a very satisfactory stand of rye, while one Marlborough line and one from South Canterbury are also fair. The other lines, though giving a good initial strike and early growth, have now practically disappeared.

In the case of the red clovers the initial strike and early growth were poor, but at the end of the first year a marked improvement was observed. English late red and Montgomeryshire are commencing to show up to advantage as compared with Marlborough and Canterbury. Both Swedish and Chilean gave a very poor germination.

## Dairying Records.

The 1930–31 season saw the completion of the fifth year of dairying on the Puwera Farm. Though satisfactory progress has been made in carrying-capacity, the butter-fat returns have been seriously affected by the prevalence of abortion and temporary sterility in the herd. Twenty-one cows were milked in the 1926–27 season, producing 4,826 lb. of butterfat; thirty-seven cows in 1927–28, producing 7,139 lb.; and forty cows in 1928–29, producing 7,369 lb. Both the 1927–28 and 1928–29 seasons were exceptionally dry during the summer months, and, as the farm was then badly supplied with water, butterfat production suffered considerably. In both seasons also a number of cows were either milked through or had aborted.

The herd of forty-five cows milked in the 1929–30 season comprised seventeen cows and seven heifers calved normally, eight cows and heifers which had aborted, eleven cows milked through from the previous season, and two cows which were dry until April. The season was a good one for grass-growth, and 20 acres were cut for silage, and 14 acres which had got away from the stock were mown for hay. The water-supply was adequate, and more feed was available than in any previous year, but the butterfat production dropped from 7,369 lb. to 6,239 lb. Few of the cows which had aborted or those milked through gave a satisfactory production.

During the 1930–31 season fifty-three cows and heifers were milked on 112 acres of grassland. Four of the cows were milked through from the previous year and eight had aborted. The spring was exceptionally cold and wet, and the summer dry. The butter-fat production showed an increase to 9,298 lb. Fifty-eight out of sixty cows and heifers were in calf by the end of December, and culling of the herd on production and age has been possible for the first time for several years.

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# TOETOE OR NEW ZEALAND PLUME-GRASS.

B. C. Aston, Chief Chemist, Department of Agriculture.

Toetoe, the well-known giant grass called in England and elsewhere New Zealand plume-grass (*Arundo conspicua*), grows in almost any situation. It is equally at home on fixed and mobile sand-dunes where, according to Dr. L. Cockayne, it is able to elongate the stems to cope with gentle sand burial after the manner of the sand-binders; also on coastal rocks and screes, on sandy shores, on open new ground, and on the mountains (for instance, on Tarawera eruption mud it forms a close growth). Toetoe is therefore a great colonizer of vacant spaces, such as the drier ground of New Zealand flax-swamps and in river-beds. It is also one of the first plants to populate a moraine with embryonic scrub near the Westland glaciers and in clearings in white-pine swamps. Thus the toetoe is evidently a plant which will accommodate itself to any vacant waste space, giving a character to the wild countryside as distinctive as that given by either flax or cabbage-tree.

The well-known enormous tussocks of tough, drooping, saw-edged leaves, surmounted by the handsome panicles or plumes gracefully drooping from the long cane-like stems up to 10 ft. in height, are a distinct feature of odd corners on most farms. Toetoe is often grown in gardens, and may be readily propagated from seeds or by subdivision of the clumps. It has a distinct use as a boundary plant and wind-break. In Europe it is esteemed for the same ornamental purpose as pampas-grass (*Gynerium argenteum*) in plantations, but with the advantage over the latter that toetoe produces the flowering plumes much earlier in the season.

The fact that stock sometimes make an attempt to browse toetoe suggests that an analysis might show interesting results, and indeed this is found to be so, for, comparing the figures given by authorities for oaten chaff or oaten hay, toetoe figures are favourable enough to warrant a further study of the plant, seeing that if chaffed the leaves and stems are greedily eaten by horses and cattle. Probably these animals are prevented from browsing the tussocks extensively owing to the tough nature of the leaves and their cutting-edges. When chaffed, these defences of the plant disappear. In considering the figures in the accompanying table it must be remembered that the toetoe samples in two cases came from poor, unmanured, waste land near Rotorua and Upper Hutt,

and that they are compared with oats presumably grown on better-quality soil which was tilled and possibly manured. It appears that if toetoe were grown on soil of good quality it would show a corresponding response in the quality of its fodder.

*Comparative Analyses of Toetoe, Pampas-grass, and Oaten Hay.*

| Laboratory No. | Date collected. | Plant. | Dry Matter. | Percentages calculated on Dry Basis. | | | Remarks. |
|---|---|---|---|---|---|---|---|
| | | | | Ash. | Nitrogen ($N_2$). | $\times 6{\cdot}25$ = Protein. | |
| | | | Per Cent. | | | | |
| 8128 | 16/6/31 | Toetoe .. | 89·98 | 7·53 | 0·83 | 5·18 | From R. Butler, Upper Hutt. |
| 8130 | 27/6/31 | Toetoe .. | 89·11 | 6·50 | 0·98 | 6·12 | From Rotorua. |
| 8126 | 17/4/31 | Toetoe .. | 95·14 | 5·07 | 1·13 | 7·06 | From Karori, Wellington. Specimem previously oven-dried. |
| 8131 | 13/7/31 | Pampas-grass | 87·28 | 10·20 | 1·17 | 7·31 | From garden, Wellington. Specimen contaminated with soil. |
| .. | .. | Oaten hay .. | 88·5 | 6·9 | 1·3 | 8·4 | Oats in flower. Quoted from Wood's "Rations for Live-stock," 1927. |
| .. | .. | Oaten hay .. | 88·5 | 6·9 | 1·3 | 8·4 | Oats in flower. Quoted from Roberts's "Fertility of the Land," 1897. Average of six analyses. |
| .. | .. | Oaten hay .. | 88·0 | 7·7 | 1·5 | 9·5 | Average of seventy-two analyses. Quoted from Henry and Morrison's "Feeds and Feeding," 1920. |

Toetoe has an historic use by the Maori, who formerly used the dry cylindrical culms or stalks, often elaborately dyed, for lining their meeting-houses. The dried flowering-stalks are of use in the garden as a temporary support for many plants.

Botanists in systematic classification allot Arundo a place near Danthonia on the one side and Poa and Festuca on the other side, showing that the toetoe is in the company of grasses of great economic importance.

Summarizing, it may be said that toetoe is a grass closely related to other grasses of approved economic value as stock-food. It will grow practically on any waste land. It has a high dry-matter content, and compares favourably with oaten chaff in protein content. Animals are fond of it, and are only deterred from grazing it by the tough nature of the leaves together with their cutting-edges, which effectually prevent extensive grazing of the tussocks. When chaffed the grass is greedily eaten. Toetoe is valuable as an ornamental plant, and may prove useful in making shelter as a hedge plant.

The matter merits further investigation, and the writer will be glad to hear observations from those who have any experience to offer. He is indebted to Mr. R. Butler, of Upper Hutt, for samples and much interesting information relative to the medicinal property of the plant.

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*Lice-affected Sheep.*—The annual report of the Live-stock Division for 1930–31 notes with satisfaction a considerable reduction in the number of lice-affected sheep found in saleyards.

# WINTON EXPERIMENTAL FARM.

## NOTES ON THE 1930–31 SEASON'S WORK.

R. B. TENNENT, Fields Superintendent, Department of Agriculture, Dunedin.

THE low prices obtainable for farm-products seriously handicapped the scope of work conducted on the Winton Experimental and Demonstration Farm during the 1930–31 season, and the Committee devoted its energies very largely to placing the farm upon a better working basis by maintaining the pastures in a high state of fertility, and in general effecting such improvements as would assist in alleviating the pressure of financial stringency. Consequently, very little new experimental work was undertaken, attention being chiefly devoted to a continuance of the work which aims largely at the solution of problems related to grassland production and management.

It has to be recorded that the Committee feels every justification for the establishment of a dairy herd on the farm, and during the past season the number of cows was materially increased and milking-machines installed. All the dairy cows were put under test, and, as opportunity occurred, culling was resorted to. It is anticipated that by the end of the present season the herd will be increased to fifty milking-cows.

### ROTATIONAL GRAZING.

Blocks 2, 4, 6, 8, and 10, comprising 25 acres, divided into fields of 2½ acres in extent, were again devoted to a rotational grazing trial. The details of this experiment were elaborated upon in the previous season's report (see *Journal* for December, 1930), five fields receiving a dressing of superphosphate and five a dressing of superphosphate and sulphate of ammonia. As a result of last season's work on these fields much valuable information was obtained, and there can be no question that rotational grazing with large numbers of dairy stock on small areas, these being moved from field to field according to grass-growth, can be commended to dairy-farmers with every justification.

Naturally, intensive grazing has to be intelligently carried out, and problems in regard to the proper control of grass are ever present. At Winton, during the flush period of grass-growth (December) great difficulty was experienced in adequately controlling the grass and keeping the pastures in a succulent condition, the mowing-machine having to be resorted to. Again, it was quite obvious that most of the fields contained poor types of white clover which made a super-abundance of summer growth, thus adding to the difficulties of control, after which the plants rapidly died off or became dormant, providing very little late summer feed. It is evident that a good type of wild white clover would materially assist the pastures to provide succulent feed well into the autumn.

One of the chief difficulties confronting farmers using the intensive system of rotational grazing with cows is the fact that, on account of the large number of animals grazed per acre, the fields become very spotted with manure, and if this is left it causes the growth of rank grass, which is not eaten by dairy stock, resulting eventually in a

patchy field of considerably lessened productivity. This result can be readily overcome by harrowing the field after the cows have vacated it, but in a climate where wet conditions often prevail the manure does not break up with harrowing, merely spreading over the grass and badly smearing it, and so rendering it unpalatable for stock. During the season under review this state of affairs repeatedly happened on the grazed fields, and farmers are strongly advised when possible not to harrow until the cow-manure is sufficiently hard to break up with the harrows. As this might mean leaving the field unharrowed for some time, it is practically certain that rank grass will grow round the cow droppings.

Winton experience shows that the "followers"—dry stock put on the fields to bare down the residual grass after the cows have taken the bloom off it—should include not only dry cows and young dairy stock, but also sheep. Sheep are very selective grazers, and will readily eat grass which would otherwise remain untouched by cattle, and it is found that the inclusion of sheep with other dry stock materially assists in attaining a more uniformly grazed field.

With the heavy per-acre stocking as carried out under a system of rotational grazing it naturally follows that the grass-production, and particularly the rapidity with which the grass recovers after heavy grazing, is the all-important feature. In the past an endeavour to obtain this state of affairs was made by the application of suitable fertilizers. There can be no denying the fact, as evinced by the Winton trials, that superphosphate is an ideal fertilizer for general pasture-production, particularly for clover-growth, and its use for general manuring should not be neglected. This fact, although now well known, is not so widely practised by Southern farmers as it should be.

The use of sulphate of ammonia, however, should only be carried out with discrimination. Admittedly it is a valuable grass fertilizer, but its haphazard application anywhere and at any time over the farm will only result in wasted expenditure. At Winton Farm, and in most places in Southland, excellent results have been obtained from mid-August applications of sulphate of ammonia, and it is now safe to say that on vigorous pastures the spring application of this fertilizer plays a most important part in the production of early or "out of season" grass. So far as early autumn applications of sulphate of ammonia are concerned, the writer has not seen general results which would justify advocating its use on grass at that period of the season.

Although suitable manuring is of the greatest importance in grass-production, of even greater moment are the components of the pasture itself. The basis for all pastures on good land is undoubtedly a mixture of rye-grass and white clover, and, as has been shown by Levy, the larger proportion of the rye-grass and white clover strains used in New Zealand are non-permanent and slow to recover after cutting or grazing. It consequently follows that only genuine certified types of perennial rye-grass and white clover should be used when fields are to be put under intensive grazing, and it can be confidently asserted that pastures sown down with such seed will not only respond better to fertilizers, but will be more persistent, more productive, and make a better recovery after grazing.

## Rye-grass Strain Investigation.

During October, 1929, a block of 5 acres was sown down with various lines of rye-grass obtained from different sources of origin throughout the Dominion. The whole object of the experiment was to ascertain whether under Southland conditions the genuine perennial types of rye-grass would assert their superiority over the pseudo-perennial types which are largely produced locally. Each plot was one-fiftieth of an acre in extent, and fifty lines of seed were sown, each plot being repeated in quadruplicate. Considerable interest has been taken in these plots by the farming community, and, as was anticipated, wide differences in types were noticed. Invariably those lines of seed originating from the Hawke's Bay, Poverty Bay, and Sandon districts proved to be very greatly superior in growth and swarding-capacity to lines originating in the South Island, thus conclusively proving that what is generally termed Hawke's Bay seed, which is equivalent to Government certified perennial rye-grass, was ideally adapted to Southern conditions, and should be the only type of seed used in the establishment of permanent pasture. Most of the plots sown with Southern seed are at present weak, open, and largely worthless, whereas those plots from Northern seed in the main are producing well, swarding thickly, and in every respect showing their superiority. There could be no greater vindication of the claims made for certified rye-grass seed than the results obtained on the experimental plots at Winton.

## Cocksfoot, Red Clover, and White Clover Strains.

In an endeavour to determine the persistence of various strains of cocksfoot and red and white clovers from different sources of origin, a 5-acre field has been devoted to a trial of such plants, this being sown down in quadruplicate series of fifty plots in the spring of 1929. Each plot, with a few exceptions, received a seeding of 20 lb. Hawke's Bay rye-grass, 3 lb. crested dogstail, 10 lb. cocksfoot, 4 lb. red clover, and 2 lb. white clover, per acre. The cocksfoot sown originated from widely different sources, such as Denmark, England, New Zealand, &c., this also being the case with the clovers.

During the first year little difference could be noted in the various plots, but as they aged variations began to be noticed. At present New Zealand cocksfoot is showing up considerably better than Danish, thus confirming the general conclusions which have been arrived at in regard to the superiority of good New Zealand cocksfoot over any others. In regard to red clovers, Montgomery has shown fair establishment, and apparently is forming a valuable constituent in the pasture. The outstanding white clover is that on Plot 43, this apparently being a good type of New Zealand wild white, which grows exceptionally well both in early spring and autumn, and is representative of the type which the Department of Agriculture is certifying. This particular strain of white clover is superior in the trials to Kentish wild white, which, however, is growing very well.

This interesting series of plots will be kept under further observation, and the present season should conclusively demonstrate the relative values of the different strains under trial.

### Hernings Swede and Club-root Resistance.

As a natural extension of previous work carried out with Hernings swede, which showed a distinct superiority over the ordinary commercial lines of seed in so far as club-root resistance is concerned, a block of land infected with club-root was sown with this variety, and a splendid crop was obtained. There can be no question that the Hernings swede is of great value to Southland growers who have in the past suffered from club-root. On such land swede-growing can be carried out, provided the land is well limed some time prior to the crop being sown and Hernings swede ridged in with a basic fertilizer.

### General.

A number of miscellaneous trials, such as origin of seed potatoes, and the use of sodium chlorate in the control of thistles, were continued and further information so obtained.

The farm continues generally to serve a most useful purpose among the farming community in Southland.

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# RELATIVE RETURNS FROM FOWLS WITH AND WITHOUT A RUN.

## EXPERIMENT AT WALLACEVILLE POULTRY STATION.

H. A. Kitto, Overseer, Wallaceville Poultry Station.

It is now generally considered that the deep lean-to structure with the front partly open is the best arrangement yet evolved for housing the high-type layer; and that fowls may be entirely confined in one of these commodious houses and lay well is now an established fact. The question frequently arises among poultrymen, however, as to whether fowls do not give a better return by being given free access daily to an outside run. With the object of testing the two systems from this aspect an experiment was carried out recently at the Wallaceville Poultry Station.

The test was commenced on 1st May, 1930, and continued until 15th April, 1931. One hundred White Leghorn pullets took part in the test, and these were divided into two lots of fifty. Each lot was placed in separate deep lean-to houses of similar design and size, and during the experiment both lots were fed alike and received identical attention, excepting that one lot were confined to their house at all times, while the other lot had free access to a large run every day during the course of the test. It may be mentioned that the birds were of the same age and strain, but were not specially selected for the test; they were a draft from an ordinary flock from which the best breeding types and also all inferior specimens had been previously removed; in short, they could be regarded as a fair even line of their breed.

With the object of giving the birds an opportunity of settling down to their new quarters they were placed in their respective houses five weeks before the test actually commenced, and at the outset the birds of both houses were given access to outside runs.

In the case of the birds which were to be entirely confined to the house at a later date the time allowed them in the outside run was daily reduced for eighteen days, after which the run was not made available to them.

During the progress of the experiment all the birds maintained a healthy, vigorous appearance, while generally the birds that were confined to the house moulted later than those which had access to a run. It was observed that the birds which had access to the outside run made free use of this during fine weather, but on cold and wet days it was rarely that any of the birds left the house. Unfortunately, the value of the experiment was detracted from to a certain extent owing to several birds in both pens going into a partial moult soon after the commencement of the test, and, as a result, these birds failed to produce for several weeks, particularly in the case of the confined lot, as more of these moulted than was the case with the others.

The following food mixtures were provided to both lots of birds during the test :—

| *Grain.* | lb. | *Mash.* | lb. |
|---|---|---|---|
| Wheat .. | 60 | Wheatmeal .. | 25 |
| Kibbled maize .. | 15 | Pollard .. | 16 |
| | | Bran .. | 13 |
| | | Meat-meal .. | 6 |
| Total .. | 75 | Total .. | 60 |

Sufficient of both these mixtures was weighed out periodically to maintain a supply for approximately ten days. The food intended for each lot of fowls was kept in separate receptacles, and was proportioned out according to requirements.

All the birds received two mash meals a day—at 7 a.m. and at midday. The grain ration for both lots was fed in deep litter between 4 and 5 p.m., according to the season of the year. The birds were given as much food as they could consume at each meal, care being taken to see that more grain food was provided for the evening meal than the birds could readily consume, as this induced them to exercise and keep busy after leaving the perches in the morning by scratching in the litter for the left-over grains. In addition to the amount of meat-meal included in the mash, this material was also placed in separate receptacles, and was always before the birds to pick at. Green food, chiefly green oats and silver-beet, was fed daily in abundance, while gravel grit and broken oyster-shell and also clean water were always left before the birds.

The accompanying tables show the quantities of food consumed by each lot during the test, also the monthly egg-yields, their market value per dozen, and the total amounts received for same. As will be seen from Table 3, there was a little difference in the total number of eggs produced by each lot, there being eighteen in favour of the confined birds. The difference between the total value of eggs produced by each lot, and also between the amount returned over the cost of food is in each case in favour of the confined birds, being £1 12s. 4¼d. and £1 8s. 1¼d. respectively. The

fact that the confined birds produced more eggs during the high-price season was chiefly responsible for their higher monetary return, and it will be noted that they consumed 4s. 3d. worth more food than did the control lot.

*Table 1.—Foodstuffs, &c., consumed by Birds during Period of Test (1st May, 1930, to 15th April, 1931).*

| Mash. | | Grain Mixture. | | Supplied in Open Hoppers. | | Fed Daily. |
|---|---|---|---|---|---|---|
| | | | | Meat-meal. | Grit. | Green Food |
| | *(a) Birds without Run.* | | | | | |
| | lb. | | lb. | lb. | lb. | lb. |
| Wheatmeal .. | 1,215 | Wheat .. | 2,086 | 379 | 279 | 816 |
| Pollard .. | 778 | Maize .. | 479 | .. | .. | .. |
| Bran .. .. | 632 | .. | | .. | .. | .. |
| Meat-meal .. | 269 | .. | | .. | .. | .. |
| Total .. | 2,894 | .. .. | 2,565 | 379 | 279 | 816 |
| | *(b) Birds with Run.* | | | | | |
| Wheatmeal .. | 1,245 | Wheat .. | 2,131 | 334 | 223 | 697 |
| Pollard .. | 797 | Maize .. | 484 | .. | .. | .. |
| Bran .. .. | 647 | .. | | .. | .. | .. |
| Meat-meal .. | 276 | .. | | .. | .. | .. |
| Total .. | 2,965 | .. .. | 2,615 | 334 | 223 | 697 |

*Table 2.—Average Prices and Total Cost of Food consumed by Birds during Period of Test.*

| Foodstuffs. | Price per Ton. | Amount consumed. | Cost of Foods. |
|---|---|---|---|
| | *(a) Birds without Run.* | | |
| | £ s. d. | lb. | £ s. d. |
| Wheatmeal .. .. | 11 10 0 | 1,215 | 6 19 8½ |
| Pollard .. .. | 8 11 2 | 778 | 3 6 7 |
| Bran .. .. | 7 12 8 | 632 | 2 8 3 |
| Meat-meal .. .. | 11 13 4 | 648 | 3 17 7 |
| Wheat .. .. | 0 7 6* | 2,086 | 13 0 7½ |
| Maize .. .. | 0 6 4* | 479 | 2 14 2 |
| Grit .. .. | 5 9 6 | 279 | 0 13 8 |
| Total cost .. | .. | .. | 33 0 7 |
| | *(b) Birds with Run.* | | |
| Wheatmeal .. .. | 11 10 0 | 1,245 | 7 3 2 |
| Pollard .. .. | 8 11 2 | 797 | 3 8 2½ |
| Grain .. .. | 7 12 8 | 647 | 2 9 4½ |
| Meat-meal .. .. | 11 13 4 | 610 | 3 3 6½ |
| Wheat .. .. | 0 7 6* | 2,131 | 13 6 4½ |
| Maize .. .. | 0 6 4* | 484 | 2 14 9 |
| Grit .. .. | 5 9 6 | 223 | 0 10 11 |
| Total cost .. | .. | .. | 32 16 4 |

* Price per bushel.

*Table 3.—Particulars of Egg Yields during Test, and Prices received.*

| Month. | Yield in Dozens. | Average Price per Dozen. | Proceeds received Monthly. |
|---|---|---|---|
| | *(a) Birds without Run.* | | |
| | | s. d. | £ s. d. |
| May | 47 6/12 | 2 9½ | 6 12 1¼ |
| June | 34 5/12 | 2 7 | 4 9 9½ |
| July | 44 5/12 | 2 1 | 5 9 10¾ |
| August | 71 8/12 | 1 5 | 5 1 7¾ |
| September | 79 | 1 2½ | 4 15 5½ |
| October | 80 1/12 | 1 3½ | 5 3 5¼ |
| November | 78 6/12 | 1 5½ | 5 14 5½ |
| December | 76 | 1 6 | 5 14 0 |
| January | 75 3/12 | 1 4½ | 5 3 5½ |
| February | 55 2/12 | 1 10 | 5 1 1½ |
| March | 44 8/12 | 1 7½ | 3 12 7 |
| April | 10 | 2 4½ | 1 3 9 |
| Total amount received for eggs | | | 58 1 8½ |
| Cost of foodstuffs | | | 33 0 7 |
| Profit over cost of foodstuffs | | | 25 1 1½ |
| | *(b) Birds with Run.* | | |
| May | 37 11/12 | 2 9½ | 5 6 0¾ |
| June | 28 5/12 | 2 7 | 3 3 5 |
| July | 49 6/12 | 2 1 | 5 3 1½ |
| August | 74 | 1 5 | 5 4 10 |
| September | 91 2/12 | 1 2½ | 5 10 1¾ |
| October | 91 2/12 | 1 3½ | 5 17 9¼ |
| November | 83 4/12 | 1 5½ | 6 6 6½ |
| December | 79 8/12 | 1 6 | 5 18 6 |
| January | 70 11/12 | 1 4½ | 4 17 6¼ |
| February | 52 10/12 | 1 10 | 4 17 0 |
| March | 36 1/12 | 1 7½ | 2 18 7¾ |
| April | 8 1/12 | 2 4½ | 1 0 9½ |
| Total amount received for eggs | | | 56 9 4¼ |
| Cost of foodstuffs | | | 32 16 4 |
| Profit over cost of foodstuffs | | | 23 13 0¼ |

The keeping of the birds under shelter all the time, and particularly during wet weather, had another compensation in that it enabled the eggs to be secured in a clean condition. There is more advantage in this than is usually realized; washed eggs never present the same attractive appearance as those taken from the nest in an absolutely clean state, and there is also the saving of labour in washing. A further consideration in connection with the confined birds was that the run connected with their house was given a good opportunity to sweeten, and will thus provide healthy conditions for the stock run on it for some considerable time.

While definite conclusions cannot be drawn from this single experiment, the results tend to favour the confining of laying pullets, especially during the cold wet season of the year. A further test on similar lines is in course of progress at the Wallaceville Station.

# SEASONAL NOTES.

## THE FARM.

### The Pastures.

It is seldom easy, even if possible, to remove from pastures weaknesses which creep into them during establishment. Hence the task of pasture establishment is a critically important one. At times the principal cause of poor pasture establishment is sowing of the seed on poorly tilled ground—ground consisting of material in a loose lumpy condition rather than fine, mellow, and firm. At other times the principal cause is late sowing of the seed.

Both of these causes may usually be traced to the starting of preparatory cultivation at too late a date. This cultivation of land which is to be sown in permanent pasture in the autumn should now be kept in view. Hurried tillage eliminates the action of natural weathering agencies, which practice has shown to be of great value in producing the fine, firm seed-bed that favours successful pasture establishment. The particular need that exists for a fine, firm seed-bed arises from the truly minute nature of the vital parts of the seeds of some of the more important pasture plants. It takes about half a million seeds of some of the kinds generally used in pasture mixtures to weigh one pound. It is easy to realize that when such small seeds are sown on uneven lumpy ground any process of covering them must necessarily bury many so deeply that they are quite unable to send their shoots up into the light if they attempt to do so. The firmness of seed-bed that comes with fineness also favours even covering of the seeds, together with a vigorous root-development.

Such considerations show that it is clearly advisable for preparation of land for new pastures to be commenced at least a few weeks before sowing. If pasture is to follow an arable crop eaten off by sheep it is often sound practice, provided the land is reasonably clean, to disk rather than to plough; the additional firmness of seed-bed given by the disking may readily be an advantage, and extra fertility provided if the animal manure is retained at the surface, where it most readily benefits the young pasture plants.

At times there are serious weaknesses in the seed mixtures used for permanent pastures. Such weaknesses may be avoided by seeking advice from the district Fields Division officers. Advice of this nature should be obtained in good time. Occasionally what is recommended in advice cannot be properly done at short notice. Practices which have come into prominence relatively recently, such as top-dressing and the use of superior strains of certain permanent species, have given greater prospective profitable life to newly sown pastures. Hence the advisability of good pasture establishment becomes increasingly greater—the influence of a weakness which creeps in at time of establishment is likely to be felt for a longer period of years than when the life of pastures tended to be shorter.

At times the swards of weak open pastures may advantageously be thickened naturally by allowing them to seed in the summer. Satisfactory renovation of swards by this method can take place only if an appreciable number of useful pasture species is present. When the seed has ripened on such pasture, drastic harrowing is advisable for the purpose of covering the seed, but such harrowing should not be done until autumn rain sufficient to establish the seedlings safely may reasonably be expected. The building-up of pastures by natural reseeding in the way just mentioned usually should

not be followed when the renewal of such pastures by ploughing and resowing can be done without undue detriment to other farm-work.

Generally, it is particularly desirable to avoid the development of stemmy rank growth of young permanent pastures during the first summer. Such development may lead to the weakening or destroying of certain species which, though relatively slow in growth in their early stages, are nevertheless of distinct value, especially on permanent pastures. When young pastures cannot be controlled adequately by the stock available, topping with a mower, as described in these notes last month, should be employed.

Pastures from which hay or silage has been saved may be expected to respond profitably to a dressing of superphosphate applied as soon as the mown material has been removed. The greater aftermath of fresh feed which can at times be obtained by the use of super in this manner is especially valuable, because it becomes available at a period when such feed is frequently needed urgently and is not provided readily by other means. This is the period between the going-off of the pasture and the becoming available of such crops as soft turnips. Such top-dressing is likely to be useful irrespective of the stage of maturity at which the pastures were mown; pastures mown at a somewhat immature stage as a rule have more vigorous aftermaths than similar ones mown at a later stage. The former generally give the greatest direct return from such top-dressing, but pastures mown at an overmature stage are frequently weakened, and so are in particular need of the stimulation provided by the top-dressing.

**Forage Crop Special Requirements.**

Over wide areas, because of unfavourable weather conditions, the amount of silage and hay saved this season promises to be much less than was planned. Further, at time of writing, it seems as if the yields of annual crops grown specially for feed will not generally be as great as usual. All this points to the necessity of taking special emergency measures in late summer and autumn, if conditions are at all suitable, in order to secure improved supplies of feed for the winter and early spring.

If favourable weather is experienced in time to allow of the necessary preparatory cultivation, a useful measure in the case of ground which if not already broken out of grass would soon be so, is the sowing of temporary pasture in the late summer or early autumn. A temporary pasture mixture generally useful consists of 25 lb. to 30 lb. Italian rye-grass and 4 lb. to 6 lb. red clover per acre. If the temporary pasture is likely to occupy the land for less than a year and quick production of feed after the sowing of the seed is specially desirable, then this mixture may usefully be modified by substituting an equal amount of Western Wolths rye-grass for half of the Italian specified. Temporary pastures must be sown early to ensure that they provide a substantial amount of winter feed, and they can generally be depended upon for a heavy hay crop in the next hay season.

When the land available for late summer or autumn sowing will be required in the spring for another sowing, it may prove well worth while to grow a catch-crop such as oats or black skinless barley—both of which are usually sown at the rate of about 2½ bushels of seed to the acre. Such cereal catch-crops under favourable conditions will yield considerable winter and early spring feed, and may be followed by roots or other suitable crops sown in the following spring. Catch-crops, after turnips which have been eaten off at a relatively early date, or after another cereal crop, may at times be sown satisfactorily with a very small amount of preparatory cultivation—disking may give sufficient tilth for the seed-bed required.

In many cases the full possible returns are not realized from temporary pastures or cereals sown for winter feed because the crops are sown too late. This is true particularly of the South Island. With such crops a dressing of 1 cwt. to 3 cwt. per acre of superphosphate is usually well worth while;

ordinarily it increases both the rate and the amount of growth. For the root crop, at times, especially when the land has been under the plough for some seasons, bonedust may usefully replace some of the superphosphate. The danger of seed injury by the use of super, as mentioned in last month's *Journal*, should not be forgotten.

If sowing of turnips and swedes has not been completed by the end of December it should as a rule be attended to as speedily as possible. When rainfall is good, sowing may continue to the end of January, but in most places after the middle of January it is safer to grow turnips than swedes, because turnips not only develop more quickly, but also suffer less from the ravages of insect pests, which sometimes appear in summer and autumn, especially in dry seasons. Hardy and Imperial Green Globe are suitable varieties of turnips for January sowing. Chou moellier, which is of good value for providing winter fodder, may often be sown successfully in January. The resistance of this plant to club-root is a characteristic which may be valuable when emergency cropping is called for, as in the present season, for it may enable the crop to be grown where the known presence of the club-root organism rules out the possibility of growing turnips.

The likelihood of success in cropping along the lines described above is lessened unless sowing is preceded by thorough preparatory cultivation. Hence, although the sowing of the crops may not be an immediate task, the cultivation of the ground may at times advantageously be proceeded with as soon as opportunity offers.

### General Cropping Work.

Every endeavour should be made to cut cereals at a suitable stage of ripeness. Investigation has shown that the best stage at which to cut wheat is when the green colour has been replaced by yellow in the section of the stem between the top knot and the head of about 99 per cent. of the straws. At this stage all knots are still green, and no dough can be squeezed from the grain, which, however, is still soft enough to cut with the thumb nail.

Generally, oats should be cut just when they have a uniform yellowish appearance, and before the final touch of green has disappeared. Fairly frequently oats for chaff are cut when too ripe; for chaff they can advantageously be cut slightly earlier than the stage described above.

Barley for malting is not cut until it is dead ripe, as if cut earlier the germination of the grain is likely to be uneven, and this lowers its value for malting purposes.

In many districts, if necessary, lucerne may be sown successfully in January, although on the basis of experience sowing in November and December is generally preferred. Lucerne seed is relatively small and, because this fact is overlooked, the seed is at times sown too deeply. It should not be sown at a greater depth than 1 in. If sufficient soil-moisture to allow of superphosphate exerting its influence is likely to be present, it is as a rule good practice to top-dress established lucerne with super after it has been mown in midsummer.

Ordinarily potatoes profitably repay considerable attention at this season. In addition to being kept free from weeds by suitable hoeing, they will usually need to be moulded up, and possibly to be sprayed for late or Irish blight (*Phytophthora*). Particularly in districts in which the ravages of blight are likely to be severe, spraying proves more effective when used to prevent instead of to remedy attacks of blight. As a rule, cheaper and more effective work results from the use of sprays prepared on the farm instead of from purchased ready-made preparations. In these notes, in the November, 1930, *Journal*, appeared a description of the method of making a modified improved Bordeaux mixture which this Department is recommending.

As a rule, thinning of crops such as mangels and carrots calls for attention at this season. If at thinning-time the young plants are pale and seem to be lacking in vigour they will probably respond profitably to a dressing of about 1 cwt. per acre of nitrate of soda or sulphate of ammonia scattered along the rows close to the plants and hoed in after thinning.

**Summer Tillage of Paramount Importance.**

Some of the more important benefits from summer cultivation are not readily apparent. Because of this they are frequently overlooked, and so at this season it may fittingly be pointed out that surface tillage in the summer, in addition to having the useful effect of destroying weeds, is of marked value as a means of preventing loss of soil-moisture by evaporation from the surface. Because a loose surface layer of soil checks the escape of moisture from the deeper soil, tillage is of particular value under dry conditions, and so it is well justified at times, even when destruction of weeds is not needed. The full significance of the influence of cultivation on soil-moisture supplies can be realized only when it is known that in many districts, especially in the drier ones, the most common cause of limited crop yields is inadequate moisture in the soil. Further, cultivation begets soil-aeration, which leads to changes that improve soil-fertility. Attention to summer cultivation usually proves particularly profitable on the part of the farmer who grows such crops as mangels, potatoes, carrots, and swedes in rows wide enough apart to allow of intertillage.

**Utilization of Summer Feed.**

Sometimes the best returns possible from special feed grown to supplement the pastures are not obtained because a commencement with the use of the feed is not made early enough. In dairying such special feed should be used not in remedying the position after an avoidable drop in production has taken place, but in preventing the occurrence of such a drop. At times this means that if the special feed is available a commencement with the consumption of it should be made shortly after Christmas, for this is when an avoidable drop in production frequently occurs, notwithstanding the fact that many seem to consider it unnecessary to do any special feeding of dairy stock until about February.

Because of the prevalence of stemmy growth in summer young growing cattle are sometimes forced to subsist on it. Actually young growing stock, such as calves, develop well only when they receive highly digestible material relatively rich in bone- and muscle-forming materials. While stemmy growth is comparatively deficient in these materials, fresh leafy growth is relatively rich in them, and so it is the latter in particular that should be fed to young developing stock.

If young lucerne sown in November or December is being seriously invaded by weeds it will probably be sound practice to mow it towards the end of January, but unless weeds are threatening to outgrow the lucerne plants it is better not to mow the lucerne so early. By leaving it unchecked one favours the development of a vigorous extensive root system, which stands the crop in good stead in subsequent competition with invaders.

In carting out soft turnips it is generally advisable to scatter them well over the field in which they are being distributed, in order that no particular area becomes unnecessarily fouled with droppings; but if the fertility of a particular area requires building up it will be advisable to concentrate the feeding out of the roots on that area.

*—R. P. Connell, Fields Division, Palmerston North.*

# THE ORCHARD.

### Use of Spreaders in Spray Mixtures.

THE use of spreading agents in spray mixtures has now become almost universal practice. Spores, in many instances very tiny things, are liable to lodge on very minute spaces which may not be covered by spray, or insects may be protected by hairs, &c. A spreader, properly used, will overcome these difficulties and give complete cover to the tree to be protected or of the insect which it is hoped to kill.

Like everything else, spreaders must be used with intelligence, otherwise the opposite extreme may be experienced and too much of the spray may run off, with the result that a sufficient coating may not be left on the fruit, foliage, or wood to be toxic to insect or spore. The amount of spreader to use will depend mainly upon the materials to be applied, but also on the pressure maintained and the type of spray coming from the nozzle. It is safe practice to reduce the amount of spreader in the case of applying liquids (such as lime-sulphur) alone, or colloids (such as Ialine sulphur) whether alone or in combination. On the other hand, the dose should be increased where coarse solids such as arsenate of lead and some of the sulphurs are used.

Where an arsenate already containing a spreader is being used alone there should be no need to add any. Growers using this type of arsenate in conjunction with some of the sulphurs and lime-sulphur consider it an advantage to add a little spreader. Care must be taken, in combining Ialine sulphur and lime-sulphur with this arsenate of lead, against too much running-off of spray and the leaving of a considerable deposit near the tips of the leaves, even where only ½ lb. to the 100 gallons of spreader had been added.

### Continuation of Spraying.

For most troubles the continuation of spraying as previously advised will be necessary, but a little longer time may now be allowed between sprays if the weather is favourable. In the case of pip fruits it is very essential to obtain a good cover of arsenate of lead before the third week in January, so as to overcome the brood of codlin-moth then hatching, if infection and stings are to be avoided. With some varieties, such as Ballarat Seedling, it is a wise precaution to shorten the time between applications in the New Year, as a safeguard against stings. With the January spray, if there is any appearance of leaf-hopper, add Black Leaf 40 at 1 pint to 100 gallons. In many orchards red mite will again be obtaining a hold. If no sulphur or lime-sulphur have been used, the use of red (winter) oil at a strength of two-thirds gallon in 100 gallons of water, or white (summer) oil at the strength recommended by the manufacturer, and, if necessary, repeated in ten to fourteen days, will, if the application is thorough, give good control of this pest.

For stone fruit the advice previously given in these notes should be followed.

### Cultivation, Irrigation, and Cover-cropping.

Orchards under clean cultivation will still, for awhile, need continuous cultivation to keep down weeds, to conserve moisture, and to prepare the ground for cover-cropping. It is generally considered that much of the spring dying-back trouble of stone fruit and pears which occurs in some districts (including Central Otago) is due to the soil becoming too dry in late summer and autumn. In irrigable orchards this may be avoided, but only too frequently the stress of picking and marketing makes it difficult to spare labour to apply the water. Specially in the lighter shingly ground, which dries up quickly, it would be a payable proposition to employ additional labour to ensure that the requisite degree of moisture is retained in the soil.

The time of sowing cover-crops must vary according to local conditions. In most districts where temporary crops, such as lupins, partridge peas, Scotch tares, &c., are grown, March is a good time for sowing. In districts with a long winter and the liability of heavy frosts interfering with growth it is desirable to sow as early in January as possible, provided the soil is sufficiently moist for germination, so that there may be a sufficient bulk before the winter sets in. In dry areas where water is available, thoroughly soak the ground. When dry enough thoroughly work up the ground into a good seed-bed, sow the seed moderately deep, and give a light rolling to firm the ground and even the surface, so that there will be less soil exposed to drying winds. When the seed is sown there should be enough moisture in the soil to give it a good start and to tide the fruit-trees and crop over until the young seedlings are well established, as it is unwise to irrigate before then.

**Picking the Fruit.**

With fruitgrowing, as with other businesses, the amount of net return to the grower is the determining factor as to whether his orchard is paying or not. Years of thought, care, and work are placed in the orchard before it comes into bearing, and for many months past all the brains and labour available have been concentrated on the present harvest. With a reasonable crop those net returns, the consummation of the year's work, will be expanded or contracted very largely by the quality and condition of the fruit when it reaches the consumer. If fruit is picked too immature or overripe, is bruised or blemished in handling, is roughly or slackly packed in a slovenly manner in a poorly got-up package, the net income is contracted and much of the labour and money put into the orchard has been lost.

There will be some variation in the stage of maturity at which the fruit may be picked, according to the use to which it is to be put and its distance from the market, but there can be no variation in the care with which it must be picked, packed, and handled generally. The general principle obtains that the longer it is desired to hold the fruit, or the farther the market, the earlier it will need to be picked. Better-quality fruit will be obtained if it is taken from the trees in several pickings as it reaches the desired maturity. Each variety and district has its own peculiarities, and only experience will teach the best time under all conditions.

Early cooking-apples for the local markets may be profitably picked as soon as they are large enough, while early dessert sorts require to show a distinct change in ground colour to a light green with a faint tinge of yellow. Stone fruits for distant markets must be fully grown yet still firm, almost hard, with the ground colour showing a very faint yellow tinge. For middle-distance markets a slight softening at the top end and a little more pronounced yellowing in the ground colour is desirable. For close markets, especially for crated fruit, a greater degree of ripeness can be allowed. With stone fruit, up to a certain stage of ripening, the longer it can remain on the trees the better the appearance, quality, and flavour.

With pears the position for most varieties is reversed, and for both flavour and keeping qualities they must be picked before there is any sign of ripening, otherwise they will become mushy and often rotten in the centre. Williams Bon Chretien and Beurré Bosc are good examples of pears which act in this manner. It is not easy for inexperienced growers to pick pears at the right stage of maturity, but if the seeds are coloured and the pear, when lifted in the palm without pressure, snaps off at the correct place it may be considered ready for picking. If the stalk breaks off, then it is too soon for most pears, and shrivelling will assuredly occur.

If inexperienced hands must be employed for picking and other work, make sure they are carefully supervised, and endeavour to get them sufficiently interested in the work to see that the fruit is placed on the market—whether home or overseas—in the pink of condition.

*—W. R. Lloyd Williams, Orchard Instructor, Alexandra.*

### Citrus Culture.

In most localities citrus trees have blossomed heavily, and the indications are for a heavy crop of fruit. However, the first promise of a good crop can be spoiled should growers not realize they have the most important part to play if the crop is to be brought to maturity in a proper manner.

Manuring: The heavy flowering and strain of setting the fruit and developing the pip will have made a fairly heavy drain upon the trees. A good deal of the ready available fertilizers will have been used up, and it will therefore be necessary to make a further application of some nitrogenous manure such as sulphate of ammonia or nitrate of soda. This could be applied at the rate of about 2 lb. per tree, and if worked into the soil would become immediately available. The quantity to be used largely depends upon the age and size of trees, also on the amount of fruit that is promising. Individual trees should always receive due consideration.

Cultivation: This should not be neglected, especially during periods of limited rainfall. Every effort should be made to conserve the moisture in the soil, as wood-production and fruit-development place considerable strain upon the trees, and nothing should be left undone that will assist them to function in a proper manner.

Young trees: These should be gone over to remove any shoots starting low down on the stem. Trees only a few years planted will now be making heavy growth. Any very strong perpendicular shoots that will not be required for the framework should be cut back to induce side growth, or if wanted for formation work the growth should be lightly tipped to ensure stability.

Pests and diseases: Young borers will now be active, and should be treated before their operations become extensive; they can be located by their castings. Where small twigs only are infected these should be removed and burnt, and the larger ones treated by injecting benzine into the holes and plugging them with soap or putty. As instructed previously, spray with Bordeaux where necessary for the control of verrucosis and grey scab. Where scales are troublesome the trees should receive an application of oil. The white oils have proved the most effective for the control of scale, and approved brands can be used at a strength of 1–60 during November, December, and January, provided none of the sulphur sprays have previously been used on the trees.

*—L. Paynter, Orchard Instructor, Auckland.*

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## POULTRY-KEEPING.

### Special Care of Late-hatched Chickens.

WHERE chickens have been hatched later than is desirable it is necessary that they should receive every consideration after leaving the brooder. Everything should be done to prevent the young birds from receiving a set-back, and to encourage healthy, vigorous development, an essential requirement for future heavy egg-production. The late-hatched chicken is always at a decided disadvantage as compared with the early-hatched bird, and this involves the necessity of giving it the best possible care and attention during all stages of its development.

Too often the late comers have to follow stock hatched early in the season, and are compelled to run on stale and tainted runs, and this is all against their making satisfactory growth. The worst mistake that can be made in this connection is to place the growing birds in runs to which adult stock have frequently had access, as the chickens are liable to become infected with internal parasites — worms, coccidiosis, &c. Just as that dangerous disease tuberculosis can be passed on from one bird to another through the

droppings, so can the germs of parasitic life be transmitted. Adult stock may do more or less well when internal parasites are present, but to chickens during the developing stage they are fatal. The importance of getting the young stock on to clean ground whenever it is possible to do so must therefore be stressed.

It should be remembered that the possession of constitutional vigour is one of the great fundamental requirements in breeding heavy-producing stock, and there is no better way of promoting this than by giving the growing stock clean ground to run on under the most natural conditions possible. Overcrowding, which is probably one of the most common mistakes made in the management of young stock after they leave the brooder, must be carefully guarded against, as healthy development cannot be expected under such conditions. The chief weakness of overcrowding is the liability of the young birds to get into a sweated condition at night, owing to their being forced to huddle together. It is a common saying that half the breeding goes down the throat; hence if birds are to make sound development or give a maximum yield of eggs they must have the stamina, and this can only be secured by liberal feeding of the right class of food. No man ever succeeded in poultry-keeping who stinted his young birds.

Another necessity for keeping the young birds in good form is a liberal supply of green material. It is surprising the amount they will eat, to their own advantage and that of the owner's pocket, as a liberal ration of green food will cause the birds to eat less of the more expensive foodstuffs. Generally speaking, it is useless to rely upon grass as green food at this time of the year. Other forms of green stuff, fed in abundance, are absolutely necessary in the chicken stage. It is only during a short period, and then not at the present time, when it is required most, that grass in the runs or even on a free range makes satisfactory green food. The young tender shoot is the grass of value. Other green foods must be supplied, such as silver-beet, cabbage, lettuce, watercress, and chopped succulent lucerne or clover—that is, when tender leaves of these plants are available.

Do not overforce the young birds at this stage. Many a good line of chickens have had their constitutional vigour wrecked by being forced like a hot-house plant. The chief cause of this is keeping the birds in closed stuffy quarters without sufficient exercise. This undesirable condition may be also encouraged by the overfeeding of rich food such as meat or meat-meal. Not only will a too liberal ration of meat tend to develop the body to such a stage that the delicate legs are unable to carry it—inducing thereby the common leg-weakness—but it unduly forces the egg-producing organs, thus bringing the birds to lay before they have reached sufficient maturity.

Cleanliness is another important factor that must not be overlooked; the later the chick the greater the need for keeping everything as sweet and clean as possible.

### Age-determination in Ducks.

A correspondent who has a flock of Indian Runner ducks ranging from one to four years old complains that owing to the bands used as a means of age-determination coming off the legs of many of the birds he is unable to distinguish their ages. This breeder is desirous of knowing if there are any signs by which he can definitely distinguish the old birds from the young ones. He further wishes to know the best way of providing a distinguishing mark for age-determination.

So far as the writer is aware, there are no means by which the age of a duck can be definitely ascertained. The condition of the windpipe, however, is a good guide as to whether or not a bird is an old or a young one. If the windpipe is hard to the touch it is safe to say the bird has reached the adult stage. On the other hand, if the windpipe is soft and yielding it

indicates that the bird is comparatively young. In applying this test to a live bird care must be taken that the windpipe is not squeezed to the extent of injuring the bird. With a dead duck the condition of the upper part of the bill gives a good indication as to its age. If a young bird the bill can be pressed back and easily broken, while if an old one this will be a difficult matter unless great pressure is used. Another way of deciding between an old and a young bird is by the manner in which the breast bone can be pierced with, say, a sharp hat-pin. With a young bird the bone can be pierced with little pressure, but in the case of an old one the reverse is the case.

### Marking Ducklings.

The best way of providing a distinguishing mark for the determination of age, strain, &c., is to take a V-shaped piece out of the edge of the web of the foot. This should be done with a very sharp penknife, the foot of the duckling being held on a piece of smooth solid board during the operation. Disappointment will generally result from using the ordinary chicken-marker for ducklings. The holes will invariably close up, although apparently obliterated marks may often be distinguished by holding the duck's foot in the line of light. Another reliable means of distinguishing the young birds from the old is the use of pig-rings. The cost of these is very small, and if properly put on (for which a ringer is required) the birds seldom loose them. This cannot be said for many of the more expensive leg-bands on the market.

*—F. C. Brown, Chief Poultry Instructor, Wellington.*

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## THE APIARY.

### Late Swarms.

THE issue of late swarms should be guarded against, as they are of little value, except as increase for next season. If increase is not required the swarms should be returned to the hives whence they originated if they can be traced. It is a good plan to kill the old queen in the swarm when returning it, at the same time destroying all but two queen-cells in the parent colony. If the hive is cramped an extra super may be given, and with this inducement the colony will usually settle down at once to work.

### Ventilation of Hives.

The matter of ventilating the hives should by now be receiving every attention. Every means should be used to ensure the bees having an abundance of fresh air day and night. All weeds and other obstructions should be removed from the fronts of the hives, and the entrances enlarged as much as possible. In extreme cases the hive-bodies should be raised from the bottom boards by means of small blocks of wood. On no account should the bees be allowed to cluster outside the hives, and wherever they show a tendency to excessive fanning steps should be at once taken to increase the supply of fresh air to the colonies.

### Provision of Supers.

One of the necessities of a well-regulated apiary is an abundance of supers when the honey-flow is in full swing. Every inducement should be given the bees during the often brief season to gather in every available drop of nectar. No beekeeper with business acumen will allow his bees to loaf or cluster outside the hives for lack of storage-room. It is well when adding additional supers to place them between the brood-chamber and the first super, or at least to raise a few frames of honey from the first super into the second when adding the latter.

It should be understood, however, that supering must not be overdone and the bees disheartened by being given too much work at one time. On no account add a second super until the bees are well at work in the first, and in cases where the colonies are only building up well at the beginning of the honey-flow—that is, where a poor colony has been requeened and the new queen's brood has not as yet hatched—it is an excellent plan to tier up with half-stories. Many an apiarist has had a moderate return from a small colony with half-stories, when it is doubtful if any return at all would have been obtained by the use of full-depth supers.

**Use of Queen-excluders.**

January is the month when queen-excluders are of most use to the beekeeper, especially in Southern districts. Whatever their disadvantage may be in some localities, in the South they have proved their efficacy in enabling the apiarist to finish extracting before the hot weather goes, without the destruction of any brood whatever. They should never be used for general purposes until the main honey-flow is in full swing. By that time the bees are used to working in the supers, and with nectar in abundance to be had all around them they will work cheerfully right through the hive, passing through the holes in the excluders as if no obstruction existed.

The best method of using the excluders is as follows: All sealed brood should be raised above the excluder, and the queen confined below on drawn-out combs. The brood above the excluder should be watched for a few days in case any eggs have been elevated, as the bees will sometimes attempt to raise queen-cells above the excluder. If this happens the queen-cells should be destroyed, as the queens which will emerge from them will not be able to pass through the excluders to get mated, and will in time develop into drone-layers. By providing the queen with plenty of empty combs she will be able to cultivate laying at a sufficient rate to keep up a supply of workers, and as the brood hatches out in the upper stories the cells will be at once filled up with honey.

Excluders are often condemned as being productive of overswarming, but in many localities swarming ceases automatically as soon as the main honey-flow commences, and if the queen is allowed plenty of room in the brood-chamber, and the brood in the supers carefully watched for the production of queen-cells, very little harm can come from the use of queen-excluders, while the immense advantage of being able to extract combs entirely free of brood is worth a great deal to the apiarist at his busiest season.

**Comb Foundation essential.**

False economy in the use of foundation will lead to the production of endless numbers of drones. If on the score of expense the beekeeper is able to buy only a limited quantity of foundation, it is by far the best policy to restrict increase and utilize only full sheets in producing good combs. It is the inside of the hive that counts. In many apiaries where good equipment is used the practice of the use of strips and half-sheets of foundation is far too common, and the result is that large numbers of drones are reared annually at the expense of the crop, instead of a profitable force of worker bees being produced. Drones thus produced by bad combs are a tax on the hive until the end of the season. It must be fully realized that drones are consumers and not producers, and while it is impossible to prevent their production altogether, even if full sheets of foundation are used, their numbers can be considerably reduced.

The advantage of the use of foundation is that it gives the beekeeper control over the brood-chamber, and in addition the bees are saved the energy required for bringing in the necessary amount of honey to produce the wax. If we estimate that it takes 1½ lb. of foundation to fit up a hive, that this costs the beekeeper approximately 5s., and that to produce this

amount of wax the bees must collect 18 lb. of honey of a value of, say, 9s., it is readily seen that the balance is in favour of the use of full sheets of foundation.

However carefully the beekeeper may furnish his hives with full sheets of foundation, he will produce sufficient drones to supply his apiary for the season. Because drone-cells require less wax to form and less time to produce, the bees will always build them wherever a gap occurs in the sheet of foundation or wherever a stray corner exists between the sheet and the frame. From every point of view the production of drone-comb in large quantities is waste. It has been estimated that a square foot of drone cells produces five thousand drones, while the same amount of space would produce eight thousand workers; so that by allowing the bees to build combs to suit themselves a beekeeper is not only considerably depleting his stock of producers, but is at the same time producing hordes of useless individuals which will absorb the food and the time of the hive without any promise of ultimate return.

Devices are at different times placed before the beekeeping industry with a view to economizing the use of foundation and even to eliminate it altogether. There has never yet been devised any successful substitute for full sheets of foundation. The apiarist should at all times aim at getting combs as near perfect as the bees can build them, and these can only be produced by using complete sheets of foundation. Combs composed partially or entirely of drone-brood may be used as extracting-combs, but they can never profitably be placed in the brood-chamber, and in a well-regulated apiary all combs should be interchangeable.

Good drawn-out worker-combs are, next to the bees themselves, absolutely the best asset the beekeeper has, and their production and care should be arranged for all the year round. Many beekeepers could minimize the cost of their foundation if they would carefully conserve every piece of waste wax which the bees produce. These pieces melted and clarified, together with cappings and any combs which may be condensed, could during the off-season be consigned to any local maker of foundation to be made up and returned to the beekeeper in time for the season. By doing this he would find his foundation bill considerably reduced year by year. But, whatever his methods may be, he must always bear in mind the fact that no beekeeper can be wholly successful who allows his bees to build unlimited drone-comb, and that whatever form his economy may take it should never take that of using half or quarter sheets or strips as starters of foundation.

*—E. A. Earp, Senior Apiary Instructor, Wellington.*

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## HORTICULTURE.

### Spraying the Tomato Crop.

THE statement by an experienced grower, who each year plants a large acreage of tomatoes, that spraying checked the growth of the crop, led to a discussion and a request that seasonal notes on the subject should be published in the *Journal*.

The usual effect of spraying with Bordeaux or Burgundy sprays, which are the chief ones in question, is to invigorate the crop to which it is applied, and this is sometimes very marked. However, some crops are often injured by these sprays, as, for instance, with peach trees in foliage, which cannot readily be sprayed successfully in summer with these materials without taking the greatest care in mixing and the method and time of the application. Speaking generally, where crops are burned, scorched, or checked by the application of these sprays, it is due to an unsatisfactory mixture, weak plants, or applying the spray at an unsuitable time. That there is a greater tendency to this injury where the Burgundy mixture is used is a common experience.

In spraying plants effectively no part of the operation is more important than the mixing, and it is perhaps the one in which errors most commonly occur. The usual description of the method of mixing Bordeaux is to dissolve the bluestone (copper sulphate or copper salt) and dilute it until it is half the measure of the total mixture; then slake the quicklime (rock lime) by adding water slowly, and when completed stir in cold water until the milk of lime is equal in measure to the bluestone solution; next run the two solutions simultaneously into the spray tank. This method is quite the best way, and, barring accidents, the result is a mixture the colour of turquoise and of a gelatinous consistency that gives it exceptional adhesion for a long period, which, of course, means long service in protecting the crop from attack. What has happened is that the acid copper sulphate has been acted upon by the basic (alkaline) milk of lime, and has been converted into a fine pale blue precipitate that is now copper hydrate, which is almost insoluble in water, but is gradually dissolved by mineral or organic acids. The gelatinous consistency which gives adherence lasts only for a short period, and it is for this reason recommended that the spray should be applied on the same day as it is made.

More often, owing to the absence of the dilution tubs, the bluestone solution is placed in the spray tank and water is added, making it up to about three-fourths of the required total. The milk of lime is then diluted to about a quarter of the total required amount, and is poured slowly into the bluestone solution, stirring the mixture well meanwhile. This method gives very fair results; but mixing concentrated solutions and then diluting them, or pouring a concentrated solution of bluestone into a dilute solution of milk of lime should never be done.

Where a small quantity of quicklime has to be slaked it is convenient to use hot water, or where it is desired to dissolve bluestone quickly hot water may be used; but it is important to note that these solutions must be cold before mixing them together, or a coarse, granular precipitate will be formed that will have poor adhesion and be difficult to keep in suspension—an altogether unsatisfactory spray. Bluestone is best dissolved in cold water suspended near the surface, as the solution, being heavier than water, sinks.

Another way to spoil a spray mixture of this kind is to use a galvanized iron dipper in the bluestone solution. The zinc is instantly dissolved off the iron, and the resulting Bordeaux is of a greenish colour and quite unsuitable for use as a spray. Containers of tin and iron are also corroded by the acid bluestone solution, but vessels of wood, copper, glass, or earthenware successfully resist its action.

Where much spraying has to be done stock solutions of bluestone and lime should be made and kept separate until required for use. They must, of course, be of known strength; usually 1 lb. of each material is dissolved in each gallon of water. To make a Bordeaux spray place the necessary amount of bluestone solution in the spray tank and dilute same to the extent of three-fourths of the total volume. Then pour in the milk of lime, slowly stirring well meanwhile.

For spraying deciduous fruit-trees in winter it is no disadvantage, and perhaps otherwise, if the Bordeaux mixture is acid. But such a condition would severely check the growth of tomato plants. A Bordeaux mixture is acid when a portion of the bluestone solution remains unchanged after adding the milk of lime. Most of the bluestone may be precipitated, but if the quantity of lime is insufficient some remains free and its acidity would cause damage. The remedy, of course, is to add more milk of lime, which exerts the peculiar quality of an alkali by neutralizing the acidity. We then have a neutral mixture—one which is neither acid nor alkaline—and it is generally most effective. By adding still more milk of lime in excess of what is required to neutralize acidity, we then have an alkaline mixture, and its action as a fungicide is at least delayed, although some growers, chiefly

perhaps in other countries where the conditions are different, consider an alkaline mixture is safer for certain plants, chiefly fruit-trees.

This demands a method of proving when a Bordeaux mixture is acid or otherwise. One of the simplest is to place a piece of bright steel in the liquid, and if any free bluestone is present some of it will be instantly deposited on the steel as a copper coating and indicate that more lime should be added.

Another method—and probably the best—is to place a little of the mixture in a saucer and allow a drop of a solution of yellow prussiate of potash (ferrocyanide of potassium) to fall in it, when immediately contact with any free copper present turns it a dark colour—an indication that more lime is needed to make it a neutral mixture. When it is added the test should be repeated. No change in the colour of the prussiate used indicates that the acid present has been neutralized.

A very popular method of ascertaining if the mixture is acid, neutral, or alkaline is by means of the use of litmus paper. This is an unsized paper saturated with a dye known as litmus extracted from certain lichens. As usually supplied these papers are a bright blue. As it is one of the peculiar properties of acids to turn vegetable blue colours red, one has only to dip a slip of blue litmus paper into a Bordeaux mixture and to observe its behaviour. If this paper turns a reddish colour the mixture is acid—that is, it contains free copper, and more milk of lime should be stirred in and the mixture tested again, as it is important that all acidity should be neutralized by the alkaline ingredient before the spray is applied to a tomato crop.

In making Bordeaux the alkali used is rock lime, as previously stated; but where rock lime is not available sometimes washing soda (carbonate of soda) is used in its place. As these crystals contain a great deal of water, the weight of soda required is rather greater than that of lime—usually about 25 per cent. A spray made in this way is spoken of as a Burgundy mixture. This spray would no doubt have a better reputation if more care were taken to make it properly and test it to be sure all acidity was neutralized.

In either case the amount of bluestone in the mixture is the most important feature in spraying successfully to prevent fungus diseases attacking the plants. For plants in foliage during the summer, a standard Bordeaux is 4-4-40—that is, 4 lb. of bluestone, 4 lb. of rock lime, and 40 gallons of water. The formula is sometimes given as 5-5-50, &c., but in any case it cancels down to 1-1-10, and as a gallon of water weighs 10 lb. it will be seen that all these formulas make up a mixture which contains 1 per cent. of bluestone. Where plants are young or weak, it is often advisable to make the first application at about half that strength, and increase the amount of bluestone in subsequent applications.

For some years the tomato crops have been subject to the attack of a large caterpillar which eats its way into the fruit. It is the larva of a moth known scientifically as *Heliothris armigera*, and more commonly as the "boll-worm," the notorious enemy of cotton and maize crops in the United States. Latterly, a caterpillar, much smaller but very numerous, has attacked the crop by tunnelling the stems, chiefly the main stem, for a few inches above the surface of the ground. This is the larva of the small moth named *Gnorimoschema melanoplintha*. To combat these pests arsenate of lead should be added to the Bordeaux mixture. The paste or powder form, whichever is used, should be placed in a bowl and worked up into a cream with a little water, then diluted further and finally stirred into the Bordeaux. Five ounces of paste or 2½ oz. of powder is sufficient for 10 gallons of the spray.

In addition to exercising care in the selection of the ingredients, weighing them out, and mixing them, it is important to apply the spray mixture

at the most suitable time and in an intelligent manner, repeating the application as may be required. To do this with economy and efficiency, it is necessary to be familiar with the life-history of the parasitic insects and fungus organisms that attack the crop, their habits, and preferences for conditions and varieties of plants; these are often peculiar and very marked. To apply the spray in bright weather when the foliage is functioning vigorously is not advisable, as it is more apt to cause damage and good adhesion is difficult to obtain. It is best done in dull weather when there is no wind, and the evening or towards the end of an afternoon is usually a suitable time for the work. As most of the diseases attacking the tomato crop appear about the base of the plants, that part should receive special attention when making an application.

To suggest that as soon as spraying is finished for the day the pump and tank should be washed clean may sound trite, but unfortunately the reminder is necessary, as much burning of crops and unsatisfactory work is due to old mixture left over in the tank or pump. Add to this a fair period of time and the use of sundry sprays, and the deposit becomes thick and of miscellaneous composition, causing unexpected chemical reactions.

### The Homestead Garden.

Where the planting of trees and shrubs is contemplated during the coming season—that is, between the months of May to August inclusive—the results will be best where the work is carefully considered now, and the plants required are inspected in the nursery and the order booked for delivery as soon as the season arrives. The plants may then be heeled in so soon as they come to hand, and be planted out according to plan when time and the state of the ground permits.

Under some extreme conditions, where the land is poor and very exposed, pines underplanted with elaeagnus may be necessary for a first-line shelter; but in most instances nothing could be better for the purpose than some of our native evergreen trees and shrubs. Whatever else may be stated about our native plants, for evergreens in variety and every position they cannot be excelled. For this reason they should always be used in the homestead garden for shelter and a background for the more showy plants, which always fail badly without this provision. For this purpose nothing is better than our Olearias, silver and golden, or Pittosporums, especially tarata and karo. *Coprosma Baueri* (taupata) perhaps excels them all for windy positions on the sea-coast. *Dodonaea viscosa* (akeake) is also suitable for such a position, as is the famous pohutukawa (*Metrosideros tomentosa*). The ngaio (*Myoporum laetum*), and very specially papauma (*Griselinia littoralis*), are all excellent in habit and constitution for such a position. Others suited to exposed positions are the koromikos—the Veronicas or Hebes—and Senecios. These are generally of a dwarfer habit, but thrive in windy places; in fact, such conditions are necessary to obtain the best results.

For more ordinary positions "five-finger" (*Nothopanax arboreum*); wharangi (*Melicope ternata*), with pale green foliage; mahoe (*Melicytus ramiflorus*); titoki (*Alectryon excelsum*); the Coprosma species, and that best of all evergreen for almost any position, the karaka (*Corynocarpus laevigata*), are all very suitable. These are not generally the more showy of our native plants, but the more compact trees and shrubs of moderate height that are so useful for fillers and creating a warm environment that is so necessary and desirable for the protection and display of plants that are attractive on account of their larger flowers, fragrance, attractive fruits, or other special character.

Excellent evergreens for sheltered, shaded positions are tawa (*Beilschmedia tawa*), horopito (*Drimys colorata*), porokaiwhiri (*Hedycarya arborea*), and kawakawa (*Macropiper excelsum*).

—*W. C. Hyde, Horticulturist, Wellington.*

# WEATHER RECORDS: NOVEMBER, 1931.

Dominion Meteorological Office.

In marked contrast to last year, when November was one of the coldest ever experienced, the past month has been a particularly warm one, the mean temperature at a number of places being the highest recorded in November for many years.

*Rainfall.*—Over the greater portion of the Dominion it was also a very dry month, Taranaki and isolated places in the far North and South being the only parts of the country where the total rainfall exceeded the average. The greatest deficiencies occurred in the Nelson and East Coast provinces. The continued dry weather in these districts has had the effect of retarding the growth of vegetation, cereal crops in South Canterbury especially. A fairly general rain, however, about the 21st was very helpful. Unfortunately, Hawke's Bay received little or no rain at this time. In most other parts of the Dominion, on account of occasional local showers and warm temperatures, vegetation made fair growth. For instance, in the Central portion of the North Island, the sultry conditions which had prevailed culminated in some severe thunderstorms accompanied by heavy downpours on the afternoon of the 14th. This rain was of immense benefit to the Waikato district. In Taranaki, also, where rain was more plentiful, feed grew rapidly.

*Pressure Systems.*—The month opened with dull misty weather under the influence of a small cyclone, the centre of which passed through Cook Strait on the night of the 2nd. During the first three days rain fell in most districts, the falls generally being only light, but some good totals were recorded in the Taranaki and Wellington Provinces.

An intense anticyclone moved on to New Zealand on the 4th, and from the 5th real summerlike weather set in and persisted until the 20th, hot temperatures prevailing at times. During this period, however, particularly from the 12th to the 15th, high temperatures and conflicting winds between two anticyclone centres were favourable to the development of thunderstorms in the Central portion of the North Island.

On the 19th the anticyclone which had persisted for a fortnight at last definitely commenced to move away, and a westerly type of pressure set in and continued to the close of the month. This period was a very windy one, north-westerlies to westerlies prevailing, backing at times to south-westerly, but rainfall was confined chiefly to districts with a westerly aspect, the eastern provinces continuing to experience dry and warm weather, except for occasional showers in Canterbury which came with the temporary southerly changes. Such changes occurred on the 21st, 24th, and 30th, and on the two latter days they were accompanied by heavy hail showers on parts of the South Island coasts. Particularly violent downpours of hail occurred at places in Canterbury on the night of the 24th. Snow also fell at this time on many of the ranges of the South Island, and a severe frost which followed the storm, on the morning of the 25th, was responsible for serious damage to vegetable crops in the Canterbury District and also to many orchards in Central Otago.

On the afternoon of the 30th Christchurch experienced a heavy hailstorm. Many other parts of Canterbury also had severe hail falls.

Except for the unpleasant local phenomena above mentioned, and for a generally deficient rainfall, the month on the whole proved a particularly pleasant one.

RAINFALL FOR NOVEMBER, 1931, AT REPRESENTATIVE STATIONS.

| No. | Station. | Total Fall. | Number of Wet Days. | Maximum Fall. | Average November Rainfall. |
|---|---|---|---|---|---|
| | *North Island.* | Inches. | | Inches. | Inches. |
| 1 | Kaitaia .. .. .. | 1·41 | 13 | 0·55 | 3·10 |
| 2 | Russell .. .. .. | 2·91 | 8 | 1·14 | 2·41 |
| 3 | Whangarei .. .. | 2·86 | 15 | 0·75 | 2·97 |
| 4 | Auckland .. .. | 1·68 | 13 | 0·61 | 3·33 |
| 5 | Hamilton .. .. | 3·89 | 12 | 1·77 | 4·10 |
| 6 | Rotorua .. .. | 3·00 | 10 | 0·74 | 4·17 |
| 7 | Kawhia .. .. .. | 5·26 | 15 | 1·94 | 4·54 |
| 8 | New Plymouth .. .. | 5·46 | 17 | 1·94 | 4·73 |
| 9 | Riversdale, Inglewood .. | 12·05 | 14 | 3·71 | 9·12 |
| 10 | Whangamomona .. .. | 8·75 | 8 | 2·57 | 7·38 |
| 11 | Eltham .. .. .. | 3·21 | 12 | 0·75 | 4·48 |
| 12 | Tairua .. .. .. | 2·15 | 11 | 0·77 | 4·01 |
| 13 | Tauranga .. .. | 2·22 | 12 | 0·79 | 3·36 |
| 14 | Maraehako Station, Opotiki | 2·93 | 10 | 1·32 | 3·13 |
| 15 | Gisborne .. .. | 0·69 | 5 | 0·48 | 3·00 |
| 16 | Taupo .. .. .. | 4·80 | 16 | 2·01 | 3·48 |
| 17 | Napier .. .. .. | 0·18 | 5 | 0·07 | 2·50 |
| 18 | Hastings .. .. | 0·44 | 7 | 0·16 | 1·75 |
| 19 | Taihape .. .. .. | 2·04 | 16 | 0·32 | 3·55 |
| 20 | Masterton .. .. | 1·82 | 8 | 0·65 | 2·79 |
| 21 | Patea .. .. .. | 4·52 | 10 | 1·47 | 3·99 |
| 22 | Wanganui .. .. | 3·42 | 8 | 1·22 | 3·28 |
| 23 | Foxton .. .. .. | 2·79 | 7 | 1·12 | 3·26 |
| 24 | Wellington .. .. | 2·61 | 9 | 0·95 | 2·90 |
| | *South Island.* | | | | |
| 25 | Westport .. .. | 7·82 | 14 | 1·90 | 8·85 |
| 26 | Greymouth .. .. | 8·35 | 15 | 1·85 | 9·01 |
| 27 | Hokitika .. .. | 5·78 | 14 | 1·02 | 10·80 |
| 28 | Ross .. .. .. | 9·32 | 12 | 2·37 | 14·15 |
| 29 | Arthur's Pass .. .. | .. | .. | .. | 16·34 |
| 30 | Okuru .. .. .. | 10·04 | 19 | 1·26 | 13·03 |
| 31 | Collingwood .. .. | 4·39 | 7 | 2·36 | 7·35 |
| 32 | Nelson .. .. .. | 0·57 | 4 | 0·35 | 3·03 |
| 33 | Spring Creek .. .. | 0·95 | 5 | 0·41 | 2·50 |
| 35 | Hanmer Springs .. .. | 2·39 | 8 | 0·83 | 3·07 |
| 36 | Highfield, Waiau .. .. | 1·75 | 7 | 0·68 | 2·56 |
| 37 | Gore Bay .. .. | 1·88 | 4 | 0·76 | 2·22 |
| 38 | Christchurch .. .. | 0·65 | 6 | 0·23 | 1·95 |
| 39 | Timaru .. .. .. | 0·92 | 6 | 0·36 | 1·95 |
| 40 | Lambrook Station, Fairlie .. | 0·44 | 5 | 0·14 | 2·03 |
| 41 | Benmore Station, Clearburn | 0·51 | 6 | 0·25 | 2·10 |
| 42 | Oamaru .. .. .. | 1·04 | 11 | 0·35 | 1·93 |
| 43 | Queenstown .. .. | 1·67 | 10 | 0·53 | 2·74 |
| 44 | Clyde .. .. .. | 0·83 | 5 | 0·44 | 1·35 |
| 45 | Dunedin .. .. | 2·31 | 14 | 0·58 | 3·27 |
| 46 | Wendon .. .. | 1·10 | 8 | 0·30 | 2·77 |
| 47 | Gore .. .. .. | 2·31 | .. | .. | 3·23 |
| 48 | Invercargill .. .. | 3·48 | 18 | 0·70 | 4·37 |
| 49 | Puysegur Point .. .. | 8·57 | 25 | 0·84 | 8·28 |
| 50 | Half-moon Bay .. .. | 5·65 | 21 | 0·88 | 5·81 |

# REVIEW.

**The Rust Fungi of New Zealand,** together with the Biology, Cytology, and Therapeutics of the Uredinales. By G. H. Cunningham, M.Sc., Ph.D., F.N.Z.Inst., Government Mycologist, Plant Research Station, Palmerston North, New Zealand. Printed privately by John McIndoe, 76 Vogel Street, Dunedin, N.Z. 1931.

"THE order, entirely parasitic, is economically perhaps the most significant of the fungi. The annual losses to agriculture caused by 'rusts' have been computed at upwards of £100,000,000 in cereal crops alone. It is not surprising, therefore, to find that a great deal of time has been devoted to their study, with the result that in certain phases of investigational work the accumulated knowledge is fairly complete." Thus we read in the introduction to the important work just to hand from the pen of the Government Mycologist. To be able to combat your enemy it is as well to find out all you can about him—his strength and his weakness, his ways of life. In the second part of his book, Dr. Cunningham devotes 120 pages to a detailed study of the systematics of the rusts occurring in New Zealand, as so far known—some 146 species, grouped into fourteen genera and two families. Clear-cut keys and excellently reproduced original drawings enable the investigator to "run down" any rust with which he is confronted. It is interesting to note that over half of the species are confined to New Zealand, thus paralleling the high percentage of endemic species found in the flowering plants. Cases are noted where these "native" rusts have spread to introduced hosts, and a few where introduced rusts have spread to native plants. The detailed descriptions of life-stages, the lists of hosts, and the meticulous synonymy will be invaluable to workers both here and abroad, and the whole provides a great advance in the systematics of the group, and marks a distinct stage in the botanical history of our country, which hitherto has shown comparatively little reference to our non-flowering plants.

Of the first part the author says that it has been written "with a view to bringing together in condensed form matter which has been published in many scores of papers scattered throughout the world's periodicals. Every care has been taken to make this compilation as completely modern as possible, and it is believed that no important contribution of recent years has been overlooked." A perusal of the pages evidences that the author's purpose has been amply fulfilled, the bibliography, with its 455 references, gives further testimony to the completeness of the work. The first part, of 104 pages, deals in separate chapters with the morphology and cytology of spore forms; the germination, viability, and factors affecting viability of the spores; the entry and penetration of the host, host factors affecting penetration; the dissemination and perpetuation of the rusts; parasitism; biologic and physiologic specialization; the evolution of families and genera; technique; classification.

The whole constitutes a complete text-book on the rusts that will appeal to all botanical workers, while it should be welcomed by the specialist as a convenient digest of a great literature. In the hands of students, whether University or private, it should prove a stimulus to research, and provide a sound foundation of up-to-date knowledge. While not intended directly for "the farmer" it brings together information that lies at the basis of any adequate schemes of control of pests that so much concern him. He too, in the chapter on therapeutics, will find a reasoned statement of the present knowledge concerning methods of control that will repay his reading.

The general get-up of the book, its logical and clear arrangement, and its excellent illustrations, reflect credit on author and printer alike. The latter, too, is to be congratulated on his remarkable success in setting up what must have been very "difficult copy."

H. H. A.

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*Microscopic Examination of Wool-samples.*—During the past year a considerable number of samples have been microscopically examined for farmers by the Wool Instructor of the Department of Agriculture. In each case a report has been sent to the woolgrower as a guide to avoiding the use of faulty rams.

# ESTIMATES OF THE SEASON'S LAMBING.

FOLLOWING are estimates of the current season's lambing in New Zealand computed from estimated average percentages furnished by Inspectors of Stock. Corresponding figures for the five previous years, together with the actual number of lambs tailed therein, are also given for comparison.

| Year. | Number of Breeding-ewes. | Estimated Average Percentage of Lambing. | Estimated Number of Lambs. | Actual Number of Lambs tailed. |
|---|---|---|---|---|
| | | NORTH ISLAND. | | |
| 1931 .. | 9,247,005 | 86·49 | 7,998,247 | .. |
| 1930 .. | 9,312,461 | 83·19 | 7,747,274 | .. |
| 1929 .. | 8,820,536 | 87·56 | 7,723,523 | 7,817,177 |
| 1928 .. | 8,211,878 | 84·61 | 6,948,380 | 7,286,284 |
| 1927 .. | 7,905,432 | 87·28 | 6,899,861 | 7,114,057 |
| 1926 .. | 7,503,200 | 84·35 | 6,329,338 | 6,459,775 |
| | | SOUTH ISLAND. | | |
| 1931 .. | 8,361,724 | 87·13 | 7,285,914 | .. |
| 1930 .. | 8,251,714 | 84·43 | 6,967,041 | .. |
| 1929 .. | 7,787,619 | 89·87 | 6,998,691 | 7,070,422 |
| 1928 .. | 7,322,173 | 87·74 | 6,424,887 | 6,569,674 |
| 1927 .. | 6,926,298 | 86·17 | 5,968,979 | 6,064,915 |
| 1926 .. | 6,445,052 | 84·79 | 5,465,361 | 5,609,906 |
| | | DOMINION. | | |
| 1931 .. | 17,608,729 | 86·79 | 15,284,161 | .. |
| 1930 .. | 17,564,175 | 83·77 | 14,714,315 | .. |
| 1929 .. | 16,608,155 | 88·65 | 14,722,214 | 14,887,599 |
| 1928 .. | 15,534,051 | 86·09 | 13,373,267 | 13,855,958 |
| 1927 .. | 14,831,730 | 86·76 | 12,868,840 | 13,178,972 |
| 1926 .. | 13,948,252 | 84·57 | 11,794,699 | 12,069,681 |

*District Estimates.*

The following table gives estimates of the current (1931) season's lambing for the several sheep districts :—

| Sheep District. | Number of Breeding-ewes. | Estimated Average Percentage of Lambing. | Estimated Number of Lambs. |
|---|---|---|---|
| Auckland .. .. .. | 1,904,883 | 86·75 | 1,652,537 |
| Napier-Gisborne .. .. | 3,669,235 | 82·19 | 3,016,030 |
| Wellington - West Coast .. | 3,672,887 | 90·65 | 3,329,680 |
| Marlborough-Nelson-Westland | 796,009 | 76·58 | 609,591 |
| Canterbury-Kaikoura .. | 3,657,769 | 87·47 | 3,199,650 |
| Otago (including Southland) | 3,907,946 | 88·96 | 3,476,673 |
| Dominion .. .. | 17,608,729 | 86·79 | 15,284,161 |

—*Live-stock Division.*

*Silage for In-lamb Ewes.*—A Clevedon farmer writes to the Editor : "It may interest you to know that, following reports in the *Journal* last year on feeding ensilage to in-lamb ewes, I adopted the practice this season with very satisfactory results. I found that the ewes ate the ensilage more readily and with less waste from improvised racks rather than from the ground."

# ANSWERS TO INQUIRIES.

**IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith Letters should be addressed to the Editor.**

### ABNORMALITIES IN FARM-KILLED MUTTON CARCASSES.

S. SPEEDY, Herbertville :—

In killing sheep on the farm for human consumption I frequently come across abnormalities which sometimes occasion concern as to whether the carcass should be used or fed to the dogs or destroyed. In the following cases I should be glad if you would name the trouble and state whether fit for human use : White cyst-like spots on liver ; bladders of water-like fluid in the fat surrounding the paunch ; hard lumps or cysts in the fat surrounding the paunch ; fat surrounding the kidneys of a darker colour than the paunch fat and flaked with markings of the usual white-coloured fat, and the whole somewhat softer than usual. Also, what are the definite indications of tuberculosis in the inside of the sheep, also of cancer ?

The Live-stock Division :—

The first abnormality referred to is a parasitic infection of sheep known as hydatid disease. These cysts are the intermediate stage in the life-history of certain tape-worms of the dog, and are met with in various stages of development and degeneration in the internal organs of cattle, sheep, and pigs. The cysts are most commonly seen in the liver and lungs, and bladder-like cysts are also frequently seen attached to the kidney-fat. The typical cyst is a thin-walled sac containing a watery fluid, but degenerated cysts may be found which are solid, cheesy, and of a yellow colour. It is apparently some of the latter cysts which you have mistaken for tuberculosis, as tuberculosis has not been reported in sheep. If a sheep is found to be severely infected with hydatid disease when killed the usual practice is to condemn the carcass for human consumption. If the liver or lungs are affected alone it is sufficient to condemn these organs, the carcass being used. Hydatids are seldom found in the muscles of animals. When a hydatid-infected carcass is to be used for dog-food precautions must be taken to boil the food before use to prevent the spread of tape-worms in dogs. Old rams are more liable to be infected with cysts than younger sheep. Cancer is very rarely seen in carcasses. Several degrees of colour in the fat are recognized, and all are considered fit for human consumption. The fat may be discoloured through the viscera being left in too long after bleeding, or as a result of bile-staining or jaundice. Soft fat is a symptom of fever in the animal at time of slaughter, and proper setting of a carcass after death is a symptom of health.

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### PREPARATION OF CHEWINGS FESCUE GRASSLAND FOR CROPPING.

"FESCUE," Willowbridge :—

Could you please tell me the right season and procedure for preparing a seed-bed for turnips from a fescue pasture ? My farm consists of easy downs situated in the Mackenzie County. I have spent a year working one fescue paddock. I have skimmed and disk-ploughed about half a dozen times, and am only just producing a semblance of a seed-bed where the fescue was thick. Is there any shorter method of attaining this end ?

The Fields Division :—

Chewings fescue land should be ploughed fairly deep and the furrows turned over as flat as possible so as to bury the fescue. Probably the swamp-plough is the best type of plough to use for this purpose. After ploughing, only surface-working should be done in the first season, and a crop of turnips or kale taken. It is generally found that the fescue has been killed in one season, but we have seen cases where a considerable regrowth appeared between the furrows. Another method that has been tried to some extent is to skim plough and work the surface for some time during dry weather, and follow with deep ploughing and a crop of turnips. The single deep ploughing has given best results. The ploughing-in and decay of the fescue turf greatly improves the general condition of the soil.

### CONTAGIOUS MAMMITIS INFECTION.

R. G. M. D., Methven :—

I have a heifer which developed mammitis very badly, and had to be dried off. She is running in the same paddock as a cow in profit and a two-months-old heifer calf. Can you tell me whether there is a risk of either the cow or the calf (when in profit) contracting the disease ?

The Live-stock Division :—

Contagious mammitis is the result of direct infection by the streptococcus of contagious mammitis ; but just how the causative organism enters the udder is unknown, although the consensus of opinion is that the usual mode of entry is through the teat orifice. Any of the following may be primary factors in the spread of mammitis : Digestive disorders, which may temporarily alter the secretion of the udder ; chills ; injuries of an acute or chronic nature which lower resistance, &c. If any of these or other factors are present and the teat orifice comes into contact with the ground contaminated by the secretions from the udder of your affected heifer, then there is a risk of infection taking place. In such circumstances it is always advisable if possible to isolate any affected cow.

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### TREATMENT OF MANGE IN DOGS.

"SUBSCRIBER," Apiti :—

Would you kindly advise as to the treatment of mange in dogs.

The Live-stock Division :—

Mange in dogs may be due to two parasites—sarcopt or demodex—which can only be demonstrated microscopically. If due to demodex, treatment is hardly worth while, except in the case of valuable animals, owing to constant recurrences. For sarcoptic mange clip areas affected also surrounding hair, bath dog, and well rub sulphur ointment into lesion and surrounding areas. Wash off in four days ; leave for twenty-four hours, and repeat dressing. This should be sufficient, though a third dressing is sometimes necessary. Feed a well-balanced ration and disinfect all kennels, &c.

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### DEVELOPING GRASSLAND ON ARAPUNI TYPE OF COUNTRY.

"INQUIRER," Arapuni :—

Would you kindly advise me as to a good grass-seed mixture to surface sow after a burn on the class of country at Arapuni. I intend to burn off a block of virgin fern and scrub, and disk and sow grass-seed in the autumn. The soil is light and of a rather pumice nature, and does not appear to hold rye-grass at all well in the early stages. Do you advise sowing down a permanent mixture, or a temporary mixture until consolidation has taken place, and then ploughing up and regrassing ? The land is easy country handy to the Arapuni dam. The covering consists of fern, manuka, tutu, and heather.

The Fields Division :—

The usual method of developing this type of country is to sow first a temporary pasture of Italian rye-grass and red clover, follow with turnips, and then sow in permanent grass. The temporary pasture improves the fertility of the land and enables better turnips to be grown than from virgin land, and the consolidation of the land through feeding-off turnips is an advantage to the subsequent permanent pasture. Permanent grass, however, may be successfully sown after the first ploughing, provided reliable strains of seed are sown and the pastures regularly top-dressed and well managed. Generally speaking, a combination of permanent and temporary sowings are necessary when developing new country, and the area devoted to each will depend on the management methods adopted. In preparing a seed-bed, both for temporary and permanent pastures, ploughing generally gives better results than disking. The strike of grass and clover is better, and pastures are usually ready for grazing six weeks to two months before pastures on disked land. After ploughing, roll on the furrow with the Cambridge roller to get con-

solidation, disk, chain harrow, and roll again before and after sowing. For a temporary pasture use Italian rye, 25 lb.; cocksfoot, 5 lb.; red clover, 5 lb.; white clover, 1 lb.: total, 36 lb. per acre. Sow with 3 cwt. of superphosphate. For a permanent pasture use the following mixture: Italian rye, 5 lb.; certified perennial rye, 20 lb.; cocksfoot, 10 lb.; crested dogstail, 2 lb.; red clover, 2 lb.; alsike clover, 1 lb.; certified white clover, 2 lb.: total, 42 lb. per acre. For permanent pasture sow down with 3 cwt. of super, and top-dress annually with not less than 3 cwt. super per acre.

## FORTHCOMING AGRICULTURAL SHOWS.

THE following show dates have been advised:—

Helensville A. and P. Association: Helensville, 29th January, 1932.
Feilding A. and P. Association: Feilding, 2nd and 3rd February.
Dannevirke A. and P. Association: Dannevirke, 9th and 10th February.
Waimarino A., P., H., and I. Association: Raetihi, 11th February.
Masterton A. and P. Association: Solway, 16th and 17th February.
Marton A. and P. Association: Marton, 24th February.
Auckland A. and P. Association: Auckland, 26th and 27th February.
Taranaki A. and P. Association: New Plymouth, 2nd and 3rd March.
Waikato Central A. and P. Association: Cambridge, 2nd and 3rd March.
Mayfield A. and P. Association: Mayfield, 12th March.
Hawke's Bay A. and P. Society: Autumn Show, Tomoana, 17th March.
Methven A. and P. Association: Methven, 2nd April.

### SOME BOOKS AND BULLETINS RECEIVED.

BAILLIERE'S ENCYCLOPEDIA OF SCIENTIFIC AGRICULTURE. Edited by Herbert Hunter, D.Sc., School of Agriculture, Cambridge. In two volumes, 6½ in. by 9½ in., xvi and 1,362 pages, with 29 plates and 44 text figures. Bailliere, Tindall, and Cox, Publishers, Henrietta Street, Covent Garden, London. Price £3 3s. net; postage abroad, 3s.

The underlying idea of this encyclopedia is the presentation of the results of scientific investigation in their application to the practice of agriculture. For the research worker, in addition to an appreciation of the existing position, the outlines of various problems are drawn, the progress towards their solution described, and the possible lines and objectives of further investigations indicated, the whole being supplemented by references to scientific publications where necessary. For the farmer are provided results of research work capable in many cases of ready adoption in practice. The list of contributors includes many eminent names in agricultural science.

THE USE OF FERTILIZERS IN TROPICAL AND SUB-TROPICAL AGRICULTURE. By A. Jacob, Ph.D., and V. Coyle, M.Sc. 272 pages, with illustrations. Ernest Benn, Ltd., Bouverie House, London, E.C. 4. 10s. 6d. net.

BEASTS AND BIRDS AS FARM PESTS. By James Ritchie, M.A., D.Sc., F.R.S.E., Regius Professor of Natural History, Aberdeen University. 270 pages, with illustrations. Oliver and Boyd, Tweeddale Court, Edinburgh. 12s. 6d. net.

BULLETIN NO. 4: ABSTRACT-REVIEW OF LUCERNE LITERATURE DURING PERIOD 1925–30. Imperial Bureau of Plant Genetics: Herbage Plants. Agricultural Buildings, Aberystwyth, Wales. 2s. 6d.

BULLETIN NO 5: RESEARCH IN PROGRESS ON HERBAGE PLANTS, FORAGE CROPS, AND GENERAL GRASSLAND PROBLEMS IN THE BRITISH EMPIRE. Ditto.

LUCERNE INOCULATION AND THE FACTORS AFFECTING ITS SUCCESS. By H. G. Thornton, D.Sc. Technical Communication No. 20, Imperial Bureau of Soil Science, Rothamsted Experimental Station, Harpenden, Herts, England. 1s. 6d.

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